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IMPERATIVE TRAUMATIC SURGERY

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IMPERATIVE TRAUMATIC SURGERY

WITH SPECIAL REFERENCE TO
AFTER-CARE & PROGNOSIS

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FIVE HUNDRED & NINETY-EIGHT
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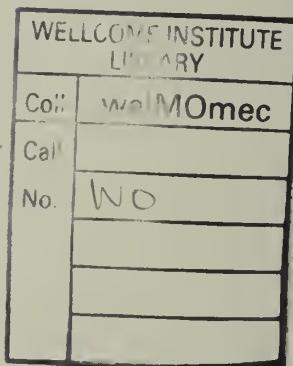
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PREFACE



The author has, for the past twenty-six years, confined his practice entirely to traumatic surgery. He spent two years' service in the World War, for one year of which period he was associated with Sir Robert Jones and Mr. T. R. W. Armour of Liverpool in the teaching of bone and peripheral nerve surgery.

The book, therefore, is a presentation of personal experiences; facts, and not theories, are presented; and only those facts in which it has been possible to check up the end results. Special attention has been paid to the immediate treatment and after-care of traumatic conditions, because the author has felt the lack of this in other treatises on the subject.

Prognosis in this type of injuries has been given particular consideration. This is a feature which the author feels to be of great importance to the physician and to all agencies connected with workingmen's compensation. Each chapter presents charts and other material aimed to assist the reader in arriving at a better knowledge of prognosis. Clarity and completeness, without verbosity, have been the author's aim.

An exceptionally large number of illustrations have been prepared, many of them actual drawings of cases at the time of operation, in order that the visual presentation of methods may not only amplify, but clarify and at the same time condense, the actual text.

The text is not written with any idea that the methods presented are the only ways in which various conditions can be treated, but to convey the methods which the author uses successfully in his own practice. All of the material included in the book has been taken from his own organization. It will be noticeable to the reader that many different methods which are represented in other texts are not shown, first, because this would only mean repetition; secondly, because the aim has been to present methods which have proven most beneficial in the author's hands.

The author trusts that this book will produce criticism, and he hopes that such criticism will be couched in such form that, by comparison, both the treatment and the prognosis of this type of work may be improved.

PREFACE

To associates in his own organization, to all others who have assisted him in getting together necessary data, and, particularly, to his publishers, because of their forbearance in this his first effort as an author, the writer of this book is truly grateful.

C. R. G. FORRESTER.

CHICAGO,
December, 1928.



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*Prognosis throughout applies to disability as well as mortality.

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IMPERATIVE TRAUMATIC SURGERY

INTRODUCTION

IN choosing the title for this volume the term "Imperative Traumatic Surgery" has been adopted, because it is perhaps more descriptive than the title, "Industrial Surgery," at first contemplated. The surgeon who treats the cases occurring in an industrial plant deals largely with cases incident to injury, and his efforts lie along the lines of active surgery and repair. Hence the fitness of the present title.

The general idea of the public in regard to the work of the traumatic surgeon seems to be that he need not concern himself particularly as to his relations with his patients, either in manners, treatment, or technique. I wish to state that no greater mistake has ever been made. It is of the utmost importance that every possible advantage be available in this service, whether of newest invention, latest discovery, closest research, intensive training and extensive experience, or scrupulous and friendly courtesy.

EQUIPMENT

The office of the traumatic surgeon who treats patients injured during work in an industrial plant should be conducted along well-defined and systematic lines; and his operating room should be organized and conducted just as efficiently as is the operating room in a hospital.

OFFICE RECORDS

Careful records should be kept, including duplicates of all original and any subsequent reports, whether to the employer, to the Industrial Commission or to the insurance company. Such reports should include full details as to treatment and the progress of the case, the development of complications, the length of the disability and the possibility of complications increasing or decreasing the patient's disability period.

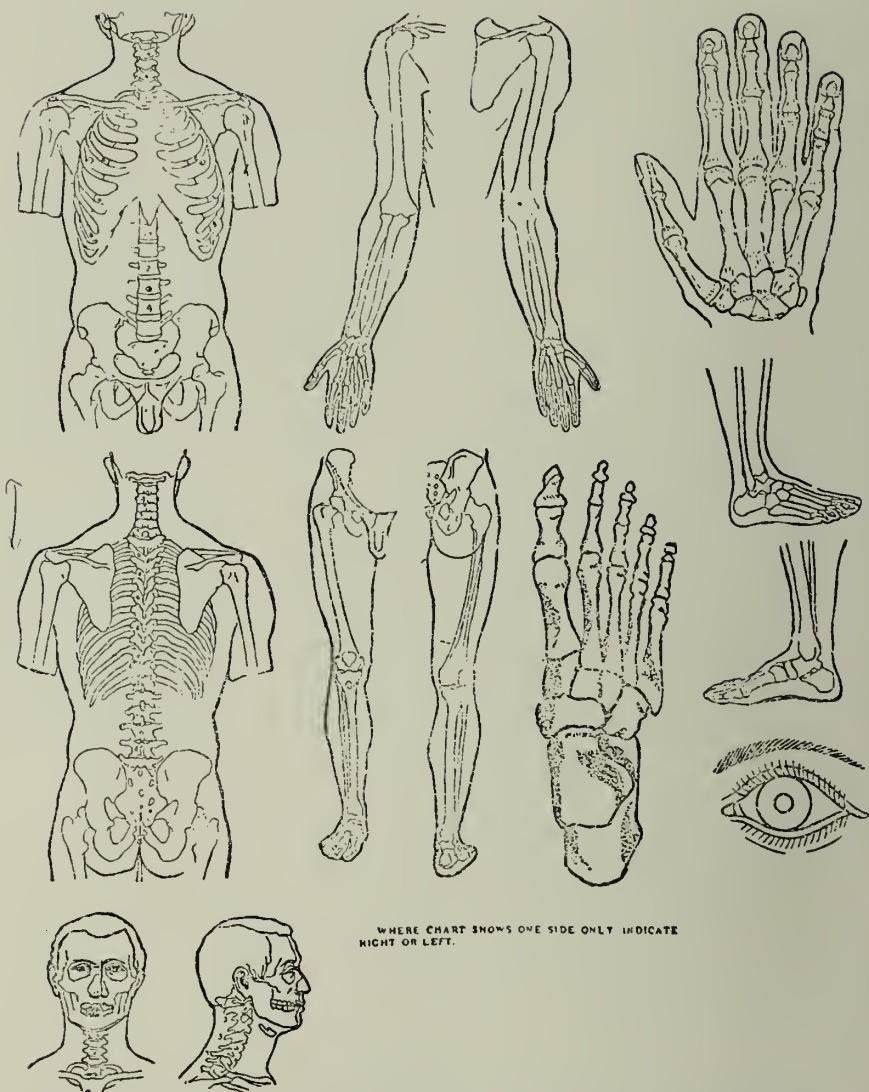


FIG. 1. Record chart adopted by the Chicago and Illinois Societies of Industrial Medicine and Surgery.

Employer _____	Address _____
Employee _____	Address _____
Occupation _____	Age _____ Check No. _____
Place of accident _____	Date of accident _____
Date of first treatment _____	Where given _____
Children under 16 years of age _____	M or S _____

Patient's story of Accident	
Previous Injuries	
Nature of Injury	
Treatment (In detail)	
Disposition of case	Work Home Hospital
Disability	When will patient return to work
Prognosis Permanency of injury	
Remarks	

Signed _____ M. D.

FIG. 2. Reverse side of chart shown in Figure 1.

IMPERATIVE TRAUMATIC SURGERY

Figures 1 and 2, demonstrating a record chart adopted by the Chicago and Illinois Societies of Industrial Medicine and Surgery, is the one preferred in the average case. In fracture cases, a supplementary record, as shown in Figure 3, is also used.

There are several important reasons for the proper keeping of records by the traumatic surgeon, aside from the obvious one of their great importance to both patient and physician, in case of litigation. One of the most important of these concerns the maintenance of a sufficient reserve fund by the insurance company. Every insurance company must maintain adequate reserves to meet future liabilities. The amount of this reserve fund is computed by estimates made by the insurance company of the amount of compensation or damages it may be called upon to pay in each case. The most important element in the making of an estimate is the prognosis of the injury given by the attending surgeon. If, for example, the surgeon gives a prognosis of six months' disability, the insurance company will establish a reserve sufficient to cover the compensation which must be paid to the injured person. Should complications develop during the treatment of his patient, the surgeon should notify the insurance company immediately in order to make sure that the reserve fund is increased sufficiently to meet the extra demands that may be made upon it.

It is readily seen that if these reserves are not accurate that fact may seriously affect the finances of the insurance company or the employer, if the employer is a self insurer, for the obvious reason that the financial standing of any company is computed upon the totals of its assets and liabilities, the latter consisting largely of those varying amounts which must be paid out in the future. Therefore any inaccuracy on the part of the traumatic surgeon in estimating his patients' disability will affect this computation. Moreover, special rates of premiums for the insurance coverage are frequently based upon the experience of the particular risk, and in order to compute that experience it is necessary to consult these reserves. Hence any inaccuracy might well materially affect the computation of the correct premium to be paid by the assured to the insurance carrier.

Hence a great optimism in the estimation of disability is to be strictly avoided, and a pessimistic forecast rather than one that is

FRACTURE RECORD

FRACTURE RECORD						
Name	Address					
Age	Sex	M. F.	M. S. W. D.	White or Colored		
Occupation						
Cause of Fracture						
Bone	EXAMINATION		TREATMENT	RESULT		
Site	Closed Reduction			Good	Moderate	Bad
Type:	Method and Position of Fracture					
Sterile	Transverse		Anesthetic Used	Yes	No	
Compound	Oblong		Anatomical Benefit obtained			
Intra-plate	Stable					
Subperiosteal	Irregular					
Greeneck	Comminuted					
Description of Deformity (includes shortening)						
Anatomical Benefit obtained						
Nature and Extent of Injury to Soft Parts especially nerves and vessels						
Was a non-operative treatment tried first?						
How long after injury was operation performed?						
Was internal fixation material subsequently removed?						
Why?						
X-Ray				Morality	Date	
Before Reduction			When			
After Reduction				Period of Convalescence		
At Discharge				Period of Protection		
Wasserman Test				Total Period of Protective Treatment		
Compensation obtained: Yes? No?						
Black Ink: Screen's Opinion Red Ink: Patient's Opinion						

ture cases, supplementary to that shown in Figures 1 and 2. Reverse side shown in Figure 1*b*.

FIG

too hopeful represents the proper attitude. But in this connection it might be well to add that, in view of the fact that these reservations are for the purposes above referred to, and are and can be nothing more than estimations, it would be decidedly ill-advised to bring such an estimate to the attention of the patient, both because of the effect it would have on his own attitude toward his injury and because of the fact that it would inevitably tend to give him, in view of actual developments, an exaggerated idea as to the amount of compensation he should receive.

The traumatic surgeon should be sure that his reports promptly reach the company employing the injured worker, since this course allows time for a thorough and fair investigation. Prompt receipt of the surgeon's report plus that of the employer usually means that the injured worker is speedily acquainted with the amount of compensation that he may fairly expect. In cases of injury in which the company is not liable, the timely receipt of reports may also be of legitimate financial value to the company itself.

THE TRAUMATIC SURGEON'S ATTITUDE

TOWARD HIS PATIENT. The attitude of the traumatic surgeon toward a patient in industrial work should be that of any surgeon toward any private patient. Indifference and haughtiness are exactly as unwarranted attributes in the traumatic surgeon as in any physician in any other field. If one sees fit to engage in traumatic surgery, he should accept the obligations entailed; and the proper equipment and the proper attitude toward his patient are most important points of departure on the road to the successful practice of this type of surgery.

TOWARD THE ADJUSTMENT OF CLAIMS. The traumatic surgeon's duty lies in the treatment of his patient to the best of his ability; and if he follows this path of duty, he serves not only the injured worker but also the company employing the worker and the carrier as well.

CHAPTER I

PRELIMINARY EXAMINATION OF THE PATIENT FOR OPERATION

EXAMINATION PRECEDING GENERAL ANESTHESIA

THIS should be a standing rule for every traumatic surgeon: *No matter how simple the operation, if a general anesthetic is to be given, examine your patient beforehand and examine him thoroughly.*

Such an examination will include, as a matter of course, investigation of the condition of the heart and lungs and the degree of blood pressure; also, if the patient is hospitalized, it will include a urinalysis, a blood count and a Wassermann test. The only exceptions to this rule of thorough preoperative examination are such emergency cases as those of skull fracture or compound fracture of any kind in which, in order to save life, the surgeon is forced to perform immediate operation; but these emergency cases are only exceptions to prove the general rule. It is far safer to know before operation that diabetes exists than to have it discovered postoperatively. It is better to know that the patient has a heart lesion that precludes administration of a general anesthetic than to have a fatality on the table. It is more prudent to discover preoperatively the unsatisfactory condition of the patient's lungs than to have him develop post-operative pneumonia. In the case of war veterans, it is desirable to know before operation whether the patient has been gassed, as in such cases a general anesthetic is always extremely dangerous and very often fatal.

Even if the patient is brought to the surgeon by another physician, it does not reflect on the latter if the surgeon insists on a thorough preliminary inspection; such insistence is to be commended in the consultant, because it indicates thoroughness.

If the patient has been in the habit of having a periodical physical examination made, the surgeon may rely, as his judgment dictates, on certain findings of the periodical examination. Routine physical examinations, when made in an intelligent manner, are of advantage not only to the patient who becomes a subject for surgery but to all workers; and the more such examinations are

required by the heads of labor unions, by employers and by the workers themselves, the more their value as an economic procedure alone will become apparent.

EXAMINATION PRECEDING LOCAL ANESTHESIA

No hard and fast rule can be made for preoperative examination of patients to whom a local anesthetic is to be given; but even in these cases the patient's age, his general appearance, his apparent degree of resistance and the possibility of diabetes should be considered.

In one instance I used a local anesthetic to remove a foreign body from the finger of a fifty-year-old man. The operation was successfully accomplished, but the following day the finger was dark blue in color. A subsequent urinalysis showed sugar. Insulin and dieting were immediately started, the finger saved and the patient's health materially improved. Certainly, in such a case, preoperative knowledge of the existence of urine sugar would have minimized if not entirely precluded a serious postoperative complication.

In another instance a physician brought to me a patient with apparent traumatic gangrene, for whom he suggested an amputation of a portion of the foot. As a precaution, I insisted on a urinalysis before operation, and as a result 3 per cent sugar was found. Naturally the operation was postponed until a time when the patient's condition had become more favorable.

CHAPTER II

ROENTGENOLOGY IN TRAUMATIC SURGERY

THE importance of roentgenograms as an aid to traumatic surgery *cannot be emphasized too strongly* because of the relationship they bear to the legal aspects of the case, as well as to the diagnosis and the treatment of the patient's injury. Good roentgenological equipment should be at the free disposal of every traumatic surgeon, and he is justified in refusing to handle the work of any organization which will restrict him in the use of such equipment.

LEGAL ASPECTS

From a legal standpoint the roentgen ray is invaluable because it forms an important part of the records of the attorneys handling the case. It is also very important to the traumatic surgeon, since it may be invaluable in cases of disputed diagnosis.

THE IMPORTANCE OF CLEAR ROENTGENOGRAMS

Every roentgenogram on which the traumatic surgeon is willing to depend should show clear detail. Many times I have heard physicians testify to certain findings in a film which, because of faulty technique or a poor outfit, was not clear. Such negligence may be far-reaching in its consequences. Even though the patient may not be seriously harmed, there may follow legal action against the side presenting the false evidence and adverse public criticism with consequent loss of professional standing to the negligent physician.

The traumatic surgeon who testifies concerning roentgenological findings should be sure that he can differentiate between normal and pathological conditions.* I have heard physicians testify to the effect that a condition shown by the roentgen ray was abnormal or pathological, when, to a competent reader of clear films, the condition appeared normal.

Under the Compensation Acts of some states, the law is so interpreted that when a patient, prior to his injury, has been

* Cohn, I. Normal Bones and Joints, Roentgenologically Considered. Hoeber, N. Y., 1924.

United States Army X-Ray Manual. Hoeber, N. Y., 1925.

suffering from some pathological condition of the bony system which can be aggravated by trauma, the employer of the injured worker is held responsible. The traumatic surgeon should, therefore, by means of an early and clear roentgenogram, be able to prove the presence or absence of such a pathological condition and, in the case of pathological findings, give an opinion as to just how seriously the pathological condition is influenced by the traumatic condition.

THE PATIENT AND HIS ROENTGENOGRAMS

Generally speaking, the patient should be shown his roentgen-ray films. Adverse public criticism follows the all too prevalent policy of secrecy and, moreover, serious legal questions may arise through the neglect of the physician to explain the films to the patient. For example, in cases of fracture in which the functional result will be good but the alignment as revealed by the film only fair, the films should be shown to the patient and the fact made clear to him that improvement in the alignment can be obtained only by surgical interference. The patient can then decide whether he will be content with a satisfactory functional result or whether he will submit to an operation for improving alignment. A record of the patient's decision should be kept by the physician and copies should be sent not only to the employer but also to the Industrial Commission. By following this course the physician has done his share in preventing the possibility of a patient who does not understand the situation or who has refused operation consulting another physician at someone's suggestion, having roentgenograms taken which show the improper bone alignment and finally bringing suit for damages.

In certain states the position taken by some of the industrial commissions is to the effect that no matter how perfect the functional result, the gross appearance is changed from normal. Therefore we are forced in many instances to perform an open operation (or at least offer one) even though we as surgeons know that the injured person can do the same work as before and just as efficiently.

THE ROENTGENOGRAM AS A GUIDE TO DIAGNOSIS

Roentgen-ray films must show clear detail if the traumatic surgeon is to depend upon them for diagnosis; but even a roent-

genogram with good detail can portray nothing but the osseous system unless there is present a foreign body of sufficient density to cast a shadow on the film; for example, steel, leaded glass, lead



FIG. 4. Lateral film of skull; no fracture shown.

or the bismuth combinations used in gastrointestinal tests. Ordinarily the roentgen ray does not show cartilage, although occasionally loose bodies in the knee joint will prove of sufficient density to cast a shadow. A good working knowledge of osteology is an important asset to the traumatic surgeon in order that he may successfully diagnose normal from abnormal conditions in the skeletal structures.

In diagnosing from roentgenograms, one should not depend upon a single view. At the time of exposure, films should be made from two or three angles, or even more if necessary. It has been demonstrated in a number of cases that a film from one angle will show a fracture, whereas that taken from another angle will not. In



FIG. 5. Anteroposterior film of same skull as Figure 4, showing necessity of two views.
Fracture line is clearly demonstrated only in anteroposterior view.

fractures of the back an anteroposterior roentgenogram may fail to show the fracture, but a lateral film may demonstrate it clearly. The result of failure to take films from various angles is often serious;



FIG. 6.



FIG. 7.

FIGS. 6 and 7. Roentgenograms of case of injury of hand, demonstrating necessity of more than one view.

for instance the patient, after a period of two or three months, will still be complaining of pain in a certain portion of the spine. Roentgenograms will then show a decided change in the contour of the spine, indicating a breaking down of the body of the vertebra through continual weight-bearing without ample support (Kümmell's disease, p. 164).

Roentgenograms should be made when the injury is of the most minor nature, if the traumatic surgeon desires them. Such a procedure is only fair to both patient and physician. I have seen cases in which a simple line of fracture of a long bone would not show in the roentgenogram at the time of injury, but after a few days, either

due to weight-bearing or to lack of immobilization, the line would be clearly visible. Such a situation can be avoided if the surgeon will use his roentgen-ray machine frequently and with close attention to the details that make for good films.

THE ROENTGENOGRAM AS A GUIDE TO TREATMENT

The roentgenogram is invaluable as a guide to the treatment of traumatic conditions. To begin with, it establishes the presence of any pathological lesion of the osseous system which has existed before the injury, and thus offers the surgeon an opportunity to vary his form of treatment to suit the special conditions imposed by the lesion.

In the presence of fractures, the roentgenogram assists materially in the choice of the best method of reduction, whether manipulation under the closed method or surgical interference; and films taken at various periods during the course of treatment will act as a safe guide to progress.

In the course of treatment, the surgeon should, as has been suggested, show the roentgenograms to the patient. This is especially important in cases where the functional result is good but the alignment, as shown in the roentgenogram, may be only fair.

It is also advisable, when there is any question of an anomaly or a bilateral condition being present, to make roentgenograms of both knees or both hands, etc., as called for by the individual case.

CHAPTER III

INJURIES TO THE HEAD

HEAD injuries may be classified in the following manner:

- I. Lacerated wounds
- II. Simple concussion
- III. Skull fracture with or without concussion
 1. Linear
 - a. Vault
 2. Depressed
 - a. Simple
 - b. Compound
 3. Basal
 4. Fractures of the orbital floor

The literature of head injuries is extensive and includes discussions from the viewpoint of the neurologist, the oculist, the histologist, the pathologist and the internist. As this chapter is intended as a ready reference for the emergency treatment of traumatic head conditions, I would refer the reader to the work of specialists for full discussion on any particular phase of the subject.*

LACERATED WOUNDS

When we consider that the scalp is one of the most vascular tissues of the body, the difficulty of controlling infection is apparent. It is fortunate that such vascular tissue is particularly resistant to infection. As scalp wounds usually heal cleanly there should rarely be an infection from lacerated wounds, providing early treatment is rendered.

TREATMENT. Lacerated scalp wounds should always be treated by thorough removal of all debris and hair, and the traumatized tissues should be thoroughly removed. Hemorrhage must be con-

* Rawling, L. B. *Surgery of the Skull and Brain*. Oxford Press, N. Y., 1912.

Stewart, W. H. *Skull Fractures Roentgenologically Considered*. Hoeber, N. Y., 1925.

Baetjer, F. H., and Waters, C. A. *Injuries and Diseases of the Bones and Joints*. Hoeber, N. Y., 1921.

Whale, H. L. *Injuries to the Head and Neck*. Hoeber, N. Y., 1919.

Keen's *Surgery*, Vol. III. Saunders, Phila.

trolled before closure is completed. At times it is necessary to introduce one or two deep silkworm gut sutures, and tie snugly to stop hemorrhage. Do not permit a subcutaneous hematoma to form under any circumstances. If the wound is excessively dirty, drainage for a few days is advisable. Under these conditions it is also wise to administer a protective dose of tetanus antitoxin.

When the wound is thoroughly cleansed, mercurochrome should be applied. In my opinion collodion should never be used for dressing scalp wounds, because it seals the wounds with surrounding tissues, the result being that the wound exudate encapsulated in the dressing forms an ideal culture for bacterial growth.

While the scalp is open it is always advisable to examine the contour of the skull for any evidence of fracture in the outer table. Even under the best conditions the roentgenogram occasionally fails to show a fracture that is plainly evident upon objective examination. This is especially true of linear fractures without depression.

PROGNOSIS. Disability may last during the period of wound healing from one to seven days, provided no complications occur.

SIMPLE CONCUSSION

Simple concussion is much more disabling than is generally recognized and often causes symptoms that become chronic in nature.

SYMPTOMS. The original injury, if slight, may render the patient only dizzy; or if severe, may cause temporary unconsciousness. At times such a patient complains only of slight headache. If he is rendered unconscious the face is pale, the eyes are usually held partially open, and are fixed and expressionless. The pupils are equal, dilated and responsive to light. The pulse may be thready, the respiration weak, shallow and sometimes irregular. The temperature is often subnormal. The body may be covered with a cold, clammy sweat. There may be slight changes in the reflexes and the deep reflexes may be lost. Involuntary response can be obtained by pain stimulation, pinching or pricking the skin, pressure on the supra-orbital nerves or other strong stimuli. Any resistance causes later symptoms, including transient headaches, in some instances nausea, occasionally vomiting. *The pulse is apt to be slow and the blood*

pressure below normal. One of the most striking features following such injury in the laboring man is the psychic changes which develop. There may be a transitory loss of memory. We usually see a marked lack of confidence, an uncertainty and an unsteadiness, particularly when the patient is surrounded by crowds or in the presence of loud, disturbing noises.

Roentgenograms should always be made in order to be certain that the symptoms are not due to skull fracture.

TREATMENT. Shock is ordinarily present in such injuries and should be treated actively. Rest in bed for one to three weeks ordinarily proves sufficient in the milder cases. At times, with the exception of slight headache, there is no disability, and in such instances no internal medication is necessary. Others are benefited by the mild depressant action of luminol, aspirin or the bromides. We have often used hexamethylenamine, grains v, t.i.d. One must always pay close attention to the diet and to proper elimination. The personal equation is important; the patient's confidence must be restored and activity gradually resumed.

In the early stages a hypertonic salt solution can be administered intravenously. About 25 c.c. of a 10 per cent solution is admissible and is indicated when the patient complains, while in bed, of headache and dizziness.

In some patients symptoms persist in spite of treatment and they complain constantly of headache and dizziness. For such instances we have found that spinal puncture, repeated frequently, may offer relief. Caution must be urged in the use of spinal puncture; the fluid should always be slowly withdrawn.* Despite the difference of opinion in regard to the efficacy of spinal puncture, we have used it many times with considerable relief of symptoms. It is our custom to remove from 5 to 10 c.c. of cerebrospinal fluid, depending on the amount of pressure found and the amount of reaction, if any, shown by the patient's pulse and respiration during the course of the withdrawal. We have found it more effective to remove small quantities at frequent intervals, than to attempt to remove a large amount once a day. The cerebrospinal fluid should always be examined for blood

* The Human Cerebrospinal Fluid. An Investigation by the Association for Research in Nervous and Mental Disease. Hoeber, N. Y., 1926. Discussion following question regarding spinal puncture.

or for increased cells, and a Wassermann made. Following the spinal puncture, if the patient is kept flat in bed for thirty-six to seventy-two hours, a marked recession of symptoms will usually result. In a recent article Penfield* described his treatment of air insufflation into the spinal cord to relieve chronic headache and dizziness. We have used this treatment with marked success in the immediate treatment and relief of cases as well as in the chronic cases to which he refers.

The purpose of withdrawal of fluid from the cerebrospinal spaces is to reduce the intracranial pressure. The same effect may be accomplished with greater safety by the administration of magnesium sulphate solution per rectum. A dehydration of an edematous brain is apparently accomplished better with magnesium sulphate, following the technique described by Rand and Nielsen,† than with hypertonic saline.‡

We have found that the administration of concentrated magnesium sulphate solution, 1 oz. in 6 oz. of water, given by rectum every four hours, is very effective.

LITIGATION NEUROSIS

There remain cases, of course, which seem unaffected by all treatment. If the physician is satisfied that he has eliminated the possibility of cortical injury or increased intracranial pressure, he should suspect the beginning of a litigation neurosis. When such neurosis develops, one must determine whether it arises from the injury itself and is therefore bona fide, or whether it is due to a protective attempt on the part of the patient to prolong his disability or to get a large award for his injury. The physician may then find consultation with a neurologist to be wise and necessary. Occasionally even the neurologists are unable to give a definite opinion on this point. A lump sum settlement of many of these claims seems advisable, since it not only expedites recovery, but it eliminates litigation, which in itself is likely to prolong and aggravate the subjective symptoms.

* Penfield, W. Chronic meningeal post-traumatic headache and its specific treatment by lumbar air insufflation encephalography. *Surg., Gynec. & Obst.*, 1927, xlv, 747

† Rand, C. W., and Nielsen, J. M. Fracture of the skull. *Arch. Surg.*, 1925, xi, 434.

‡ Cushing, H., and Foley, F. E. B. Alterations of intracranial tension by salt solutions in the alimentary canal. *Proc. Soc. Exper. Biol. & Med.*, 1920, xvii, 217.

PROGNOSIS. The disability may last from a few days to a year or more, depending upon the severity of the initial injury and the severity and type of work of the patient. Death may occur in severe initial injuries, from shock or from any marked cerebral edema.

ROENTGENOGRAMS IN HEAD INJURY

Before discussing the different types of skull fractures, I want to emphasize the importance of roentgenograms in these injuries. No matter how simple the accident, and no matter how remote the possibility of skull fracture, roentgenograms should be taken in order to eliminate such a possibility. Negative evidence is of great value in these films, and is of particular importance when such injuries come up before the industrial boards. If a fracture does exist, the roentgen ray is of invaluable assistance in determining its exact type and location. On the other hand, roentgenograms which fail to show good detail are worthless, as are even excellent roentgenograms in the hands of an individual whose training in roentgenological and osteological diagnosis has been inadequate. Every physician should learn to read his own plates; he should not follow the dangerous practice of trusting to a technician alone for interpretation of the films; for there have been technicians incapable of diagnosing osseous lesions.

NUMBER OF VIEWS. Roentgenograms of every case of head injury should include at least two views, the anteroposterior and the lateral. The lateral films should be taken in a stereoscopic manner. If doubt remains after the examination of films showing the two views, films from other angles should be made. I have been able to demonstrate, by means of anteroposterior views, an extensive fracture of the frontal or occipital portion of the skull, which in the lateral stereoscopic films showed no evidence of fracture.

OLD AND RECENT FRACTURES. The roentgenogram can be used to determine whether a skull fracture is of long standing or the result of recent injury. In an old, healed process the edges of the bone are smooth and rounded; the fracture line is not sharp. In a recent fracture they are sharp, rough-edged and irregular. Not long ago we treated a patient in whom the injury was located over an old healed, lacerated wound. The second injury was not, in our opinion, sufficient to produce skull fracture. The roentgenograms, however,

showed a well-defined depressed fracture, with rather smooth edges. We learned from the physician who had treated this man some three months before that in an altercation with another employee



FIG. 8. Roentgenogram of cleared skull, showing normal skull lines.

he had been hit over the head with a pipe and sustained a skull fracture. Since this was not a compensable condition, expense was avoided by giving first aid treatment only. In such a case the physician treating the recent injury must examine the films carefully, for upon his decision as to whether the fracture was an old or a recent one rests the question of the patient's claim for compensation.

SIMPLE FRACTURE WITHOUT DEPRESSION

Fracture of the outer table without depression may be revealed by objective inspection if there is a wound of the scalp. If the frac-

ture involves only the inner table the roentgenogram is the one means of diagnosis. Do not confuse the suture or meningeal lines of the skull with the line of fracture.



FIG. 9. Same case as Figure 8.

The examination of the eye ground with the ophthalmoscope in such injuries is likely to add little to the other clinical evidences of intracranial injury. For a period, we examined the optic fundus in all skull injuries. This examination was done at the time of injury and at frequent intervals during the course of convalescence. So far we have not seen an elevated disc. In other words, edema of the optic fundus apparently comes on too slowly to be of much value in the diagnosis of acute traumatic conditions of the brain. Our experience coincides with that of other observers on this point.

PRESSURE SYMPTOMS. Due to irritation of the dura or the brain, pressure symptoms are usually although not invariably present and

include temporary unconsciousness, headache, dizziness, nausea, vomiting and possibly exaggerated reflexes. Focal or lateralizing symptoms may or may not be present.



FIG. 10. Anteroposterior view of skull, showing extensive frontal linear fracture transversely without depression. (See fracture chart, Fig. 12.)

Hematoma with pulsation suggests a break in the bony continuity, and even hematoma alone calls for an exploration for possible fracture. The middle meningeal artery may be injured at the time of fracture, and such an injury causes focal symptoms, such as increasing irritability, increased or hyperactive reflexes on the opposite side followed by paralysis, irregular pupils, rising temperature, increasing blood pressure and gradual unconsciousness.



FIG. 11. Lateral view of same case as Figure 10, showing fracture line passing laterally over temporal region.

FRACTURE RECORD					
Name	Address		3214 CRYSTAL STREET	Date	Case No. 85411
Age 22 Sex M F	M S W-B		White or Colored	Date 11-15-27 Mr. FORRESTER	
Occupation			Time of Occurrence of Accident 10-11-27		
Cause of Fracture FEEDER OF BUS HIT HIM IN BACK AND KNOCKED HIM DOWN					
Hospital Entered ST. FRANCIS					
First Treatment 10-11-27					
X-Ray No 33271 Final Reduction					
EXAMINATION			TREATMENT		
Bone SKULL	Closed Reduction NOT OPERATED			RESULT	
Site FRONTAL AREA	Method and Position of Fixation			Good	Moderate
Type				Functional	Bad
Simple	Fracture	Anesthetic Used	Yes	X	
Comminuted	Oblique	Anatomical Result obtained			
Intra-articular	Spur				
Schmidts	Impacted				
Compound	Compound				
MULTIPLE LINEAR					
Description of Deformity including abrasions FRACTURE LINE					
FROM FRONTAL PORTION TO SLIGHTLY POSTERIOR					
OF FRONTO-PARIETAL SUTURE- BOTH SIDES.					
BASE OF NOSE TO SPHENOID BONE AND BALK					
WAY BACK					
Nature and Extent of Injury to Soft Parts					
especially nerves and vessels					
ECCHYMOSIS ABOUT RIGHT EYE					
Was non-operative treatment tried first?					
How long after injury was operation performed?					
Was internal fixation material subsequently removed?					
X-Ray					
What					
When					
Before Reduction					
After Reduction					
Period of Complete Immobilization					
Period of Protection					
At Discharge					
Total Period of Protective Treatment					
Wassermann Test					
BLOOD PRESSURE 118/76					
Compensation obtained: Yes? No?					
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion					
Description of End Result, including Deformity, Shortening, Fracture, Pain, Swelling, Nerve					
(a) At discharge from Hospital Date					
WAS IN HOSPITAL 25 DAYS THEN SENT HERE					
FOR EXAMINATION.					
(b) At discharge from O.P.D.: Date 11-15-27 EYES					
REFRACTORY TO LIGHT AND ACCOMMODATION. NO					
NYSTAGMUS-RHOMBENG NEGATIVE.					
BABINSKI SLUGGISH-SUPERFICIAL TENDON					
REFLEXES EXAGGERATED.					
(c) At discharge date Date					
Disability: Absent, Partial, Complete COMPLETE					
Mortality Date					
Main cause of death					
Absence from work: Duration STILL DISABLED					
*Ability to resume job NO					
*Present Wage earning capacity					

FIG. 13. Fracture record of case shown in Figures 10 and 11.

Pulse and Temperature. The temperature and pulse at first may be subnormal, due to shock, but very shortly after injury the temperature and blood pressure rise. This holds true of any form of skull



FIG. 13. Simple fracture without depression.

fracture. In some cases, in which the prognosis should be very guarded, the temperature is at first subnormal but rises rapidly to a high level. In somewhat more promising cases the temperature rises from subnormal to 101°F . or 102°F ., remains there for a few days, and then falls. In the cases with very favorable outlook, the temperature rises from subnormal to normal and remains there.

Other Symptoms. Unilateral fixed pupils or absent reflexes, including abdominal reflexes, are very unfavorable signs in the prognosis.

Occasionally, within twenty-four to seventy-two hours after injury, symptoms of intracranial pressure appear: rapid pulse, increased blood pressure and increased dizziness upon turning the head to the affected side.

Focal paralysis may follow. It indicates hemorrhage, either extradural or subdural, or damage to the motor cortical areas of the brain.

TREATMENT. Under ordinary circumstances this type of skull fracture heals as satisfactorily as any other broken bone. Treatment in the average case is simple and follows the lines of treatment for concussion of the brain (p. 16). As in concussion, spinal puncture may occasionally be necessary to clear up the symptoms caused by either extradural or subdural hemorrhage. In the exceptional cases of severe hemorrhage in which spinal puncture is not effective a subtemporal decompression operation* must be done.

NEUROTIC COMPLICATIONS. Patients with this type of fracture, particularly if foreigners, are very apt to develop a neurosis extremely difficult to treat. For some such patients, who show no objective clinical signs but who stress their disability, the mere suggestion of an operation as a curative measure may result in speedy recovery. In other instances the question of financial settlement must be seriously considered.

One patient sustained a linear fracture extending from the frontal to the occipital region. The original symptoms, aside from temporary unconsciousness, included only high blood pressure, accelerated pulse rate and dizziness upon turning the head from side to side. Four weeks after the injury, a confirmatory set of roentgenograms having been taken, the patient developed a typical neurosis. He was sure that the roentgenograms had caused his head to bulge on the side exposed to the roentgen rays; he gradually developed pain in the back of the head and he felt certain that he was permanently injured. There was no indication for a spinal puncture. He was treated by rest, bromides and hexamethylenamine for about three weeks. It was not until, in the man's presence, I had a talk with his manager, his friend, that we convinced him that he was unduly upset and persuaded him to go back to work with a

* Cushing, H. Keen's Surgery, Vol. iii, p. 275. Saunders, Phila.

Sharpe, W. Brain Injuries. Lippincott, Phila., 1920.

temporary helper. Two months later he was doing his regular duties without any assistance.

In practically all head injuries there is a large personal element



FIG. 14. Linear fracture with depression, showing decompression operation.

that requires as much attention as does the actual injury, and in some cases more. One cannot treat them automatically; each must be handled as an individual and his peculiar idiosyncrasies studied. This applies particularly to the foreign races. The layman fears injury to his head and it destroys his confidence. This must be restored by quiet and by careful questioning and advice.

PROGNOSIS. Disability lasts from three months to a year, depending upon the severity and extent of the injury. When a complication such as a neurosis develops, the prognosis must necessarily be guarded.

SIMPLE FRACTURE WITH DEPRESSION

This type of fracture is characterized by a gradual development of symptoms; but in spite of this slow development, operation should be performed as soon as the diagnosis is established. In the

FRACTURE RECORD

Case No. 72633

Date _____ Hr. _____

Dr. FORRESTER

Name	C.M.	Address	Dr. FORRESTER										
Age	Sex	M	S.	White	Time: Occurrence of Accident 6-11-26								
Occupation CARPENTER					Hospital Entered EAST SIDE								
Cause of Fracture FELL ABOUT 30 FEET, INJURING HEAD.					First Treatment B-11-26								
					Final Reduction 4-26-27								
X-Ray No 50161													
EXAMINATION		TREATMENT			RESULT								
Bone SKULL		Closed Reduction			<table border="1"> <tr> <td>Anatomical</td> <td>Good</td> <td>Moderate</td> <td>Bad</td> </tr> <tr> <td>Functional</td> <td>X</td> <td></td> <td></td> </tr> </table>	Anatomical	Good	Moderate	Bad	Functional	X		
Anatomical	Good	Moderate	Bad										
Functional	X												
Site RIGHT PARITAL REGION		Method and Position of Fixation											
Type LINEAR													
Stable	Transverse	Anesthetic Used	X Yes	No	Description of End Result: including Deformity, Shortening, Function, Pain, Swelling, Nerve								
<input checked="" type="checkbox"/> Compressed	Ovalized	Generalized	Anesthetic Results obtained		(a) At discharge from Hospital Date 9-20-26								
True Joint	Jointed		EFFECT		WOUND HEALED, PULSE RAPID,								
Subluxating	Impacted				BLOOD PRESSURE 100								
Genuinely	Concentrated		Open Reduction B-13-26		NO PARALYSIS.								
					PERIODS HEADACHE AND DIZZINESS.								
Description of Deformity including shortening		CRANIOTOMY, RIGHT PARITAL WITH											
BLEEDING FROM EAR		REMOVAL LARGE BLOOD CLOT.			(b) At discharge from O.P.D. Date 4-26-27								
SEMI CONSCIOUS					COMPLAINS OCCASIONAL HEADACHE.								
		Anatomical Results obtained			IRREGULAR VARIATION IN REFLEXES.								
Nature and Extent of Injury to Soft Parts <i>especially nerves and vessels</i>					NO PARALYSIS OR INCORPORATION.								
					VISION POOR.								
					(c) At subsequent date Date								
					Disability: <u>Abnormal</u> Partial, <u>disorder</u>								
X-Ray		Why			Mortality								
Before Reduction		When			Main cause of death								
After Reduction		Period of Complete Immobilization			Absence from work: Duration								
At Discharge		Period of Protection			*Ability to resume job POOR								
Wassermann Test		Total Period of Protective Treatment			*Present Wage earning capacity								
					Compensation obtained: Yes X No								
					*Black Ink: Surgeon's Opinion Red Ink: Doctor's Office								

Form 19 A.C.S. Case Record System
FBI - Boston Laboratory Division

6 H

P. H.

B-1

(Details of Treatment, Operation, X-Rays, Diagrams etc.)

1-25-27. MAJOR CLINIC. DR. W. D. SHELDEN.

PHYSICAL EXAMINATION NEGATIVE - VISION BOTH EYES 6/15. PALLOR OF OPTIC DISC.

L-R HEAD IRREGULAR DEFECT IN RIGHT PARITAL AREA

NAME - FASCHERMAN, ROSE EXAMINATION NUMBER

URINE, BLOOD SERUM AND BLOOD EXCRETION NEGATIVE.
DIAGNOSIS - POST-TRAUMATIC CENTRAL SEPARATION.

POST-TRAUMATIC

Form 19 { A.C. & Case Record System
Eastern Cemetery Project

FIG. 15. Fracture record (front and reverse) of case shown in Figure 14.

general absence of focal symptoms the roentgenogram is the important factor in the early establishment of the diagnosis.

SYMPTOMS. The symptoms as a rule develop slowly and become obvious only with the gradual increase of intracranial pressure or local irritation. Some of these patients even walk into the office unassisted. They may complain of a little dizziness after the injury, and they are convinced only with difficulty that an operation is absolutely necessary in spite of the absence of pain or any other symptom. To be sure, there are cases on record in which skull fracture with depression has existed for years without causing demonstrable focal symptoms. No physician should let such exceptional cases influence him against taking a firm stand for immediate operative treatment.

The symptoms depend upon the portion of the brain involved, but usually there are present, in increasing degree, irritability, headache, dizziness, nausea and ascending changes in pulse and blood pressure. Of course, when simple fractures with depression involve the meninges or when post-traumatic hemorrhage is associated, the symptoms become definite, such as focal irritation and increased reflexes, irritability followed by increased pulse, temperature and blood pressure, together with gradual focal paralysis or lateralizing signs.

Often, if the case is long neglected, there is a proliferation of bone in callus formation which will cause further focal irritation and result ultimately in some cerebral derangement that may manifest itself in various ways, such as focal epileptic attacks or Jacksonian epilepsy.

There are, of course, patients in whom unconsciousness comes on immediately after injury, when the features are pale, the pulse and respiration slow, the extremities cold, the pupils irregular without reaction, and the reflexes absent. In these cases one often must deal with lacerated scalp wounds or hematomas which, when pulsating, indicate a break in bone continuity.

TREATMENT. This consists in operative interference as soon as the diagnosis is established. If the patient, where conscious, refuses to submit to this procedure, the physician should go on record with him and his family, the company employing the patient and the Industrial Commission, as having made a diagnosis of skull fracture with depres-



FIG. 16. Linear fracture with depression, showing decompression operation.

FRACTURE RECORD						Case No 58570	
Name	W.C.		Address	809 N. LA SALLE STREET			Date
Age 43	Sex	M ♀	M S W F	White or Colored			Dr. FORRESTER
Occupation CEMENT FINISHER						Time Occurrence of Accident 4-6-25	
Cause of Fracture A GYM POLE FELL AND CAUGHT PATIENT						Hospital Entered INERT SIDE	
						First Treatment	
						Final Reduction	
EXAMINATION			TREATMENT			RESULT	
Bone SKULL			Closed Reduction			Good	Moderate
Site RIGHT TEMPORO-PARIETAL REGION			Method and Position of Fracture				Bad
Type DEPRESSED						Description of End Result, (including Deformity, Shortening, Function, Pain, Swelling, Nerve Injury)	
Skin	Traumatic		Anesthetic Used	Yes	No	(a) At discharge from Hospital Date	
Cosplay	Oblique		Anatomical Result obtained				
Interv. Tissue	Spiral						
Subcutaneous	Incarcerated						
Cartilage	Comminuted		Open Reduction TREPHINE				
Description of Deformity including shortening			Method and Position of Fracture REMOVAL OF LARGE SECTION BONE PARIETAL, TEMPORAL AND FRONTAL BONES.			(b) At discharge from O.P.D. Date 9-5-25	
						COMPLAINTS OF DIZZINESS REFLEXES SLUGGISH ON LEFT	
Nature and Extent of Injury to Soft Parts <i>including nerves and vessels</i>			Anatomical Result obtained				
SEVERE LACERATION OF SCALP						(c) At discharge date Date	
EXTRA AND EXTRA DURAL HEMORRHAGE						Disability: Absent, Partial, Complete	
X-Ray			Why			Mortality Date	
Before Reduction			Where			Main cause of death	
After Reduction			Period of Complete Immobilization			Absence from work Duration	
At Discharge			Period of Protection			*Ability to resume job	
Wassermann Test POSITIVE			Total Period of Protective Treatment			*Present Wage earning capacity	
						Compensation obtained Yes? No?	
						*Black Ink Surgeon's Opinion Red Ink Physician's Opinion	

FIG. 17. Fracture record of case shown in Figure 16.

sion and as having advised immediate operation. Only in this way can he avoid a possible suit for malpractice and protect the employer against payment for an avoidable disability in many instances.



FIG. 18. Faulty technique in replacing pieces of bone in skull fracture. Sequestra and ultimate removal of bone necessary.

Preparation for Operation. Operation should take place a few days after the accident. Except in the cases showing dangerous focal symptoms which call for immediate operation, the interval of a few days between the time of injury and that of operation gives the patient an opportunity to rally from the effects of the traumatic insult before fighting the effects of an operation. I have waited as long as two to three weeks with good results.

The night before operation the head must be entirely shaved, cleansed with soap and water followed by ether and then covered with a sterile bandage. Immediately before operation a head tourni-

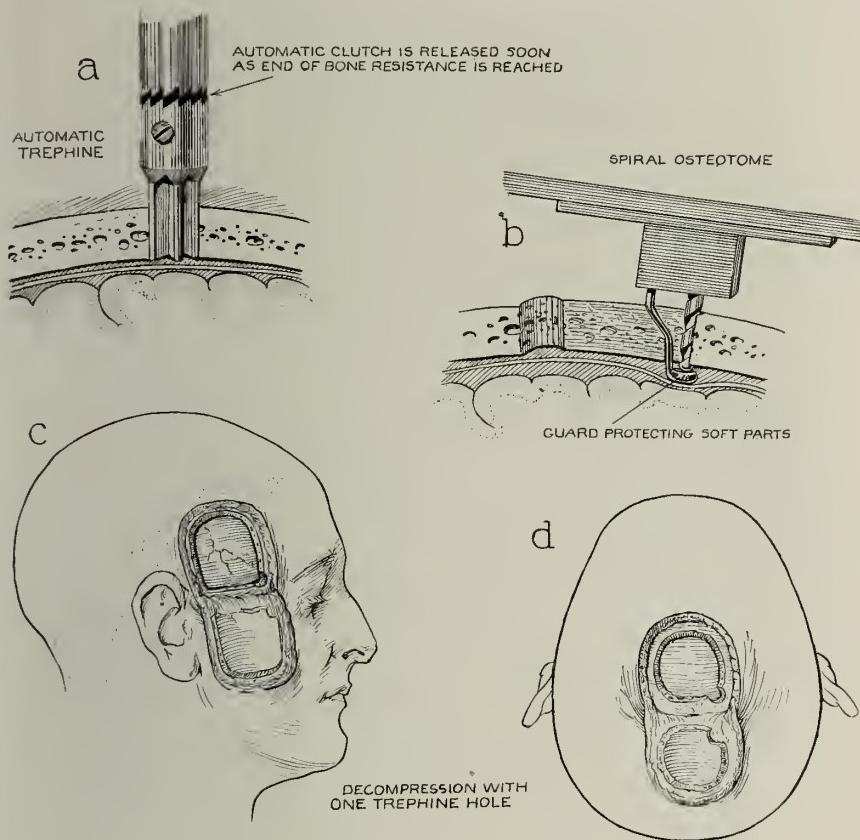


FIG. 19. Application of Hoglund instrument in skull trephine.

quet can be adjusted and the entire skull painted with iodine and alcohol.

Type of Operation. A plain decompression operation is best. The incision should be semicircular and large enough to expose freely the entire field of fracture. All fragmented pieces of bone should be entirely removed and no attempt made to replace them. Such fragments, if replaced, very often form sequestra and must eventually be removed.

In this operation an old-fashioned trephine with bone-cutting forceps, or an electrical instrument, such as the Hoglund trephine, constructed by Dr. Hoglund of Chicago, can be used. With the

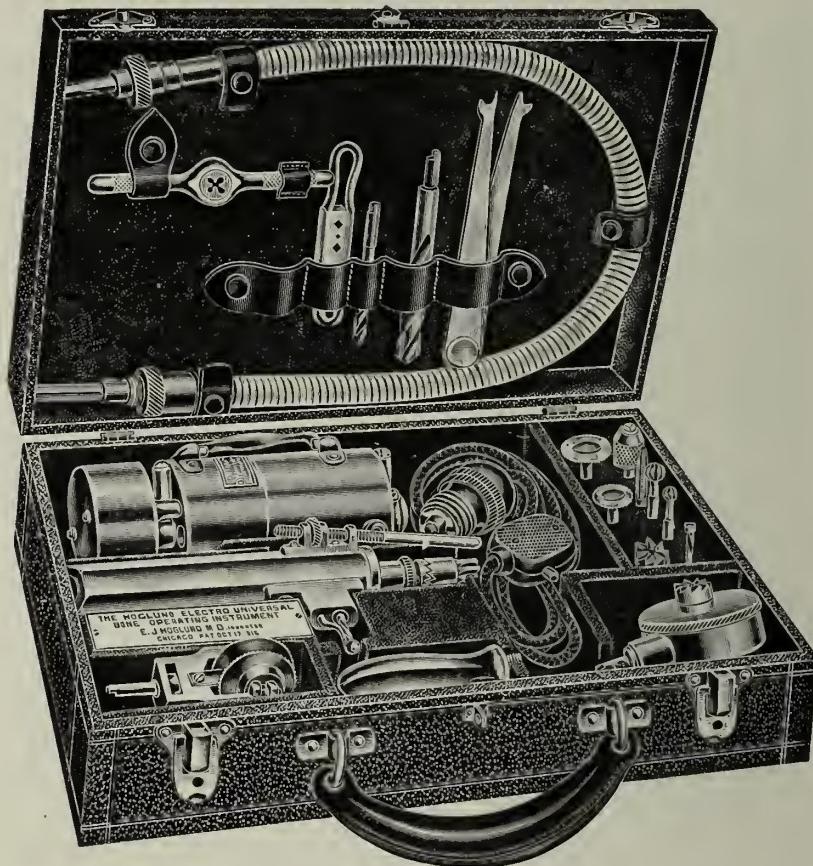


FIG. 20. Hoglund instrument in case.

Hoglund trephine, under favorable conditions, the skull can be exposed, the affected bone removed and tissues closed in fifteen to twenty minutes (Figs. 19 to 26).

In some cases of decompression in which the fracture is over the longitudinal or lateral sinuses, or in which the dura and meninges are torn, marked hemorrhage occurs. It is advisable during operation to have ready a small, fine needle with a non-cutting edge, and

single No. 00 catgut. If hemorrhage takes place, the catgut can be introduced through the dura and the wall of the vein. The artery can be likewise ligated. As such suturing will not always stop the

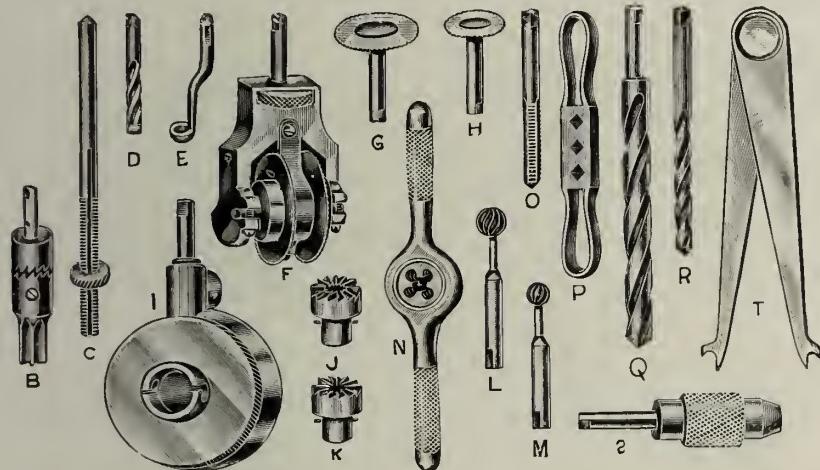


FIG. 21. Individual parts for Hoglund instrument.

B. Automatic trephine; c. Trehpine guard; d. Spiral osteotome; e. Spiral osteotome guard; f. Twin saw (spiral gear driven), cutting parallel to handle; g. Single circular saw, large; h. Single circular saw, small; i. Dowel shaping instrument; j and k. Dowel reamers; l and m. Round burrs; n. Die and holder; o. Tap; p. Tap holder; q. Twist drill; r. Twist drill for tap; s. Universal chuck for small drills; t. Combination caliper.

bleeding entirely, iodoform gauze, or any other type of sterile, non-irritating gauze, may be packed gently into the wound and allowed to remain for twenty-four, or even from thirty-six to seventy-two hours. As a rule, however, it will not be necessary to leave the gauze in place, for if it is packed against the wound and held there by the assistant, in a majority of instances the bleeding will have stopped by the time the operation is completed. The gauze may then be removed, the wound closed with drainage and a large fluff dressing and a head bandage applied.

If during the operation oozing in the diploë occurs, I pack a thin layer of Morison's bipp paste (bismuth subnitrate one part, iodoform two parts, and paraffin paste q.s.) against the oozing surface (see p. 453). Horsley's bone wax may be used to similar advantage.

Postoperative Treatment. The patient should be placed in a semi-Fowler position, a pneumonia jacket applied and a pneumococcus vaccine administered. Anodynes may be given if indicated (in fact,

morphine in $\frac{1}{4}$ grain doses is of considerable assistance), and liquids allowed only when tolerated. Catheterization should be done if the patient does not void within ten hours. If after three days no menin-

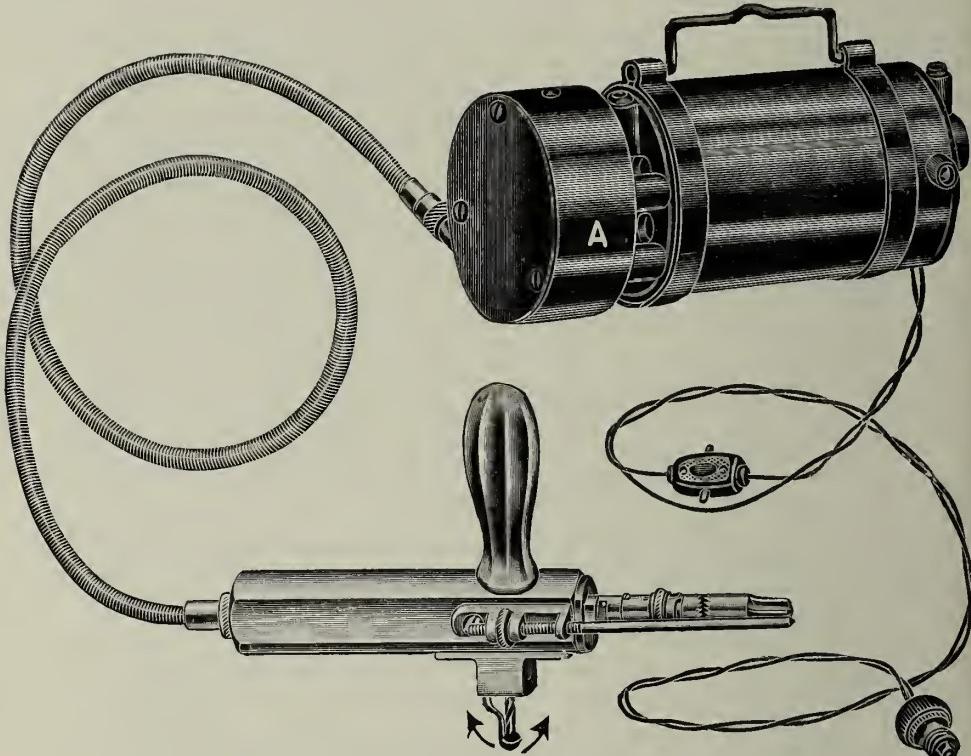


FIG. 22. Hoglund instrument. Automatic trephine and spiral osteotome set up for use.

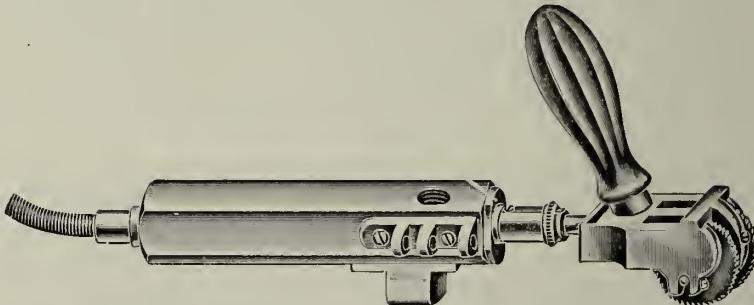


FIG. 23. Hoglund instrument. Twin saw attachment.

geal symptoms or other symptoms of infection develop, the drain can be removed. Sometimes it is not advisable to remove the entire

drain at one sitting, particularly when it starts oozing. In that case, a little each day should be removed. The semi-Fowler position should be continued, a liquid diet prescribed and the patient kept

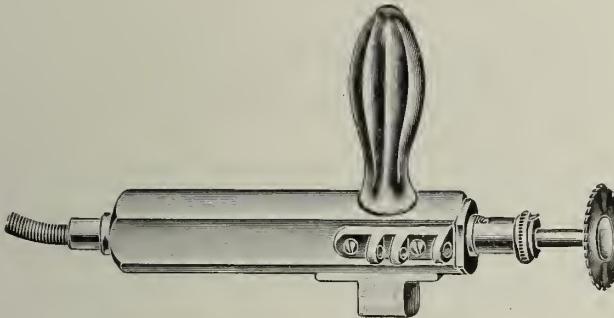


FIG. 24. Hoglund instrument. Single saws.

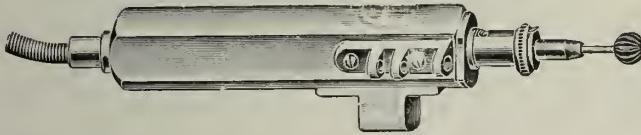


FIG. 25. Hoglund instrument. Ball-burrs for mastoid operations or for burring out diseased cavities.

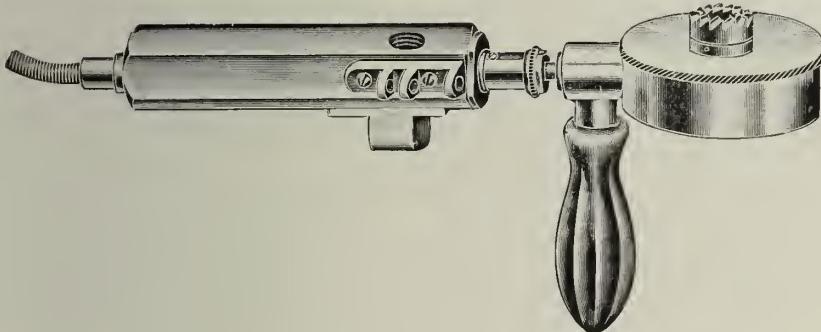


FIG. 26. Hoglund instrument. Doweling attachment.

in bed for two to six weeks, or longer, depending on the extent of the operation. As soon as rational, hexamethylenamine, grains v, t.i.d., should be given per mouth.

PROGNOSIS. The period of disability is, in the majority of instances, materially shorter than one would expect, since the decompression operation speedily clears up the symptoms. As a rule, the disability lasts from two to six months, depending upon the extent of the cortical injury and the presence or absence of such a pre-

existing condition as syphilis. One of my patients returned to work at the end of eight weeks and another after twelve weeks.

A neurosis similar to that seen in cases of fracture without depression will sometimes develop, particularly among foreign patients, and may naturally increase the period of disability.

COMPOUND FRACTURE

Cases of compound skull fracture are always emergencies, and immediately after diagnosis, since the shock and loss of blood are likely to be marked, the patient should be hospitalized and prepared for operation.

TREATMENT. *Preoperative Measures.* The head should be entirely shaved, washed with green soap and sterile water, followed by ether, and entirely painted with iodine, then alcohol. This is a simple, quick (an important point in these emergency cases) and very effective procedure. I have never had a case of sepsis following this preoperative technique. In making this statement I am not referring to meningitis, though even that complication is exceedingly rare where this care is exercised.

OPERATION. A decompression operation should be performed. A circular flap (Koenig flap) which is a semicircular incision, should be made so as to leave strong tissue over the opening when the wound is to be closed. Débridement should be most thorough, as any traumatized tissue, dirt or foreign substance encountered during operation will prove a source of infection.

When the tissues are thoroughly clean the wound should be made large enough to allow ample exposure and access to the injury. All loose particles of bone should be removed (this may be done without the use of the trephine) and all rough edges made smooth. Any rip or tear in the dura should be repaired with No. 00 plain catgut. Proper closure of the dura helps to prevent hernia cerebri. If brain substance has been destroyed and is lying free in the operative field, it must be removed before closing the dura.

Closure of the scalp should be done very carefully so that the scalp may aid the dura in preventing herniation. A semicircular flap, as already mentioned, should be employed in these cases, whenever possible. At the time of closure, iodine or mercurochrome may be applied, but this is unnecessary if débridement has been

complete. Generally I use a solution of ether and iodoform (ether 59.15 c.c., iodoform 5.53 c.c.), first covering the dura with sterile gauze and then drenching the tissues with the solution, although



FIG. 27. Extensive compound skull fracture with decompression operation.

this combination does not harm if brought in direct contact with the dura. Again I stop the oozing in the diploë with Morison's bipp paste. A drain of small character, such as flat gutta percha, is advisable for the first thirty-six hours. The postoperative treatment is the same as that following the decompression operation for simple fracture (p. 33).

PROGNOSIS. The prognosis is the same, with one exception, as that for simple fracture with decompression; i.e., disability for

three to six months. The exception is the case in which brain substance has been destroyed and such centers as those for memory or speech, or the motor center, seriously affected. Naturally, prognosis in such a case is determined with difficulty.

I have now under my care a case (Fig. 27) in which a large plate of the left side of the skull has been removed and the speech center seriously injured. There was only a transitory motor disturbance. The Wassermann test showed a four-plus reaction. This workman now has all normal functions except that of speech. Granting that a re-educational process would be successful (the syphilitic complication might prove a hindrance), one must estimate the period of disability at one and one-half to three years, with some permanent partial disability.

As in other types of head injuries, pathological complications must be considered in making a prognosis. Routine laboratory investigations are important in all these patients.

BASAL FRACTURE

A basal fracture is the most serious of all skull fractures. Roentgenograms are sometimes, but by no means always, of help in the diagnosis. The treatment is difficult and the prognosis poor.

SYMPTOMS. The symptoms vary according to the degree of injury (the history of injury is always clear-cut) and the amount of basal hemorrhage.

The injury is usually severe enough to cause at least temporary unconsciousness. There may be marked hemorrhage about one or both eyes, conjunctival hemorrhage, or hemorrhage from one or both ears and from the nose and mouth. Occasionally, along with the hemorrhage, there is a discharge of cerebrospinal fluid from one or both ears. The disturbance in respiration is marked, and sometimes Cheyne-Stokes breathing is present. The face is flushed and occasionally markedly cyanotic. The pupils are contracted and do not react to light.

During the first seven days following injury, symptoms of infection to the meninges and brain through the possible openings (mouth, nose and ears) frequently appear. Such infection results in meningitis, together with aspiration pneumonia, or passive pulmonary congestion followed by pneumonia.

TREATMENT. The first treatment in these injuries when the diagnosis is established is the administration of morphine, grain $\frac{1}{4}$, atropine, grain $\frac{1}{150}$, which not only holds down arterial tension and decreases the tendency to hemorrhage, but produces at least a temporary anoxia-association. The ears, in my opinion, should not be plugged with cotton for two reasons: first, the discharge of cerebrospinal fluid helps to control the intracranial pressure; second, plugging keeps the fluid in the ear passage and leaves a good media for bacterial development and possible meningitis. The ears should be swabbed out with dry sterile cotton. Do not irrigate. The nostrils should be packed with cotton soaked in mercurochrome.

Spinal puncture has been very successful in my own cases, in spite of the objection of many physicians to this form of treatment. I perform spinal puncture as soon after injury as possible, removing from 10 c.c. to one test-tube of cerebrospinal fluid at one time. If blood is found in the fluid, it tends to confirm the diagnosis. Spinal puncture can be done as many times as necessary without ill effects. In fact it can be done a number of times in a day if necessary. One exception to spinal puncture exists: that is when there is definite evidence of cerebrospinal fluid being liberated, as from the ear, for this acts as a substitute for spinal puncture. Dehydration by the use of magnesium sulphate solution by proctoclysis may be safely used when doubt exists as to the danger of spinal puncture. After the procedure the patient becomes quiet; but as the amount of cerebrospinal fluid and blood again accumulates and the pressure causes cerebral irritation, his blood pressure increases and he becomes restless and irritable, picking at the bedclothes and murmuring incoherently.

After spinal puncture, place the patient in either a horizontal or a semisitting posture, put on a pneumonia jacket and administer morphine to keep him quiet and to help control increase in blood pressure. He should be catheterized within eight hours after injury if he does not regain consciousness. If possible when conscious, urotropin, grains v, t.i.d., should be given. In some cases a sub-temporal decompression operation (Cushing's) may be performed, but it should be employed with great discrimination. In this type air insufflation is valuable.

PROGNOSIS. The mortality rate in basal skull fracture cases is high. Death usually occurs in from one to seventy-two hours after injury. If the patient survives, the disability may last from a year

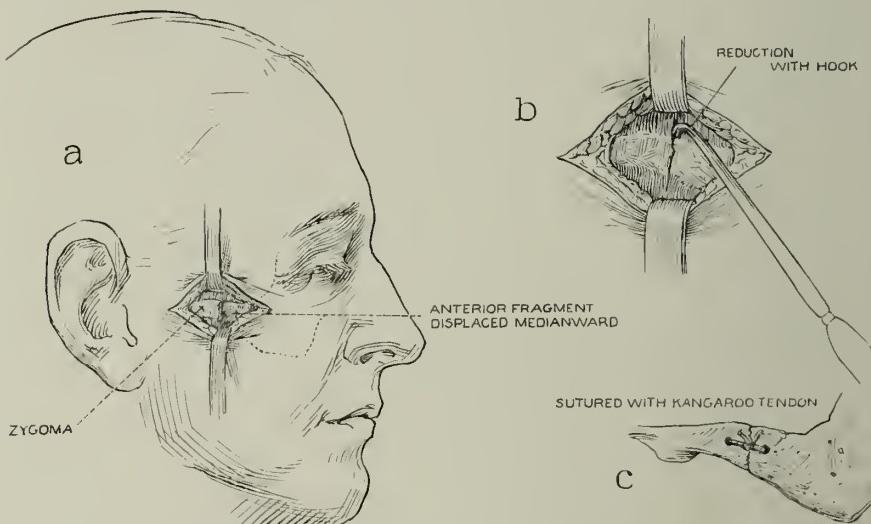


FIG. 28. Repair of fractured orbital floor to prevent double vision. Drawn from actual operation.

to sixteen months. Headache, dizziness and nausea, either singly or in combination, are very likely to persist for months after injuries of this type.

FRACTURE OF THE ORBITAL FLOOR

This fracture is quite rare, but well worth keeping in mind because of the disability it produces. The cause of this injury is a squeeze between two objects or a direct blow fracturing the floor and depressing it with the zygoma. As a rule, the fracture of the zygoma takes place at the suture line. Such injury usually causes double vision.

TREATMENT. The only treatment is surgical; by making an incision horizontal with the zygoma, exposing the fracture, then inserting a blunt hook underneath and drawing the fracture up into line and suturing, as shown in the drawing (Fig. 28), using kangaroo or plain No. 2 catgut.

This drawing was made at operation on such a patient. I am indebted to Dr. H. E. Fischer of the Chicago Rapid Transit Co., who referred this patient, for permission to publish it. Recovery in this instance was complete.

FRACTURE OF THE NOSE

SIMPLE FRACTURE

Fracture of the nose is usually a simple one, although occasionally a compound condition occurs.

SYMPTOMS. Symptoms are trauma, epistaxis, swelling, redness, deformity, tenderness and crepitus upon manipulation. The easiest method of determining crepitus is to hold the patient's head against your chest and by lateral manipulation determine whether there is any preternatural mobility or crepitus.

Occasionally the fracture will be shown in a lateral view, providing there is a bony displacement. Where there is a separation of the cartilage at the nasal septum a roentgenogram will not show it, although one can still obtain crepitus.

TREATMENT. This comprises external molding with the introduction of a nasal splint into each nostril. Keeping the air passages clean is all that is necessary, because these splints not only act as a support, but by automatic pressure gradually control all hemorrhage and oozing. The best method of internal fixation is a curved, perforated rubber splint, such as is on sale in any instrument house. This can be left in for about two weeks.

It is not always possible to mold the external contour of the nose as one would like, or make it appear as it was before the accident, but, providing one keeps the air passages clean and clear, the main object is accomplished.

COMPOUND FRACTURE

Compound fractures are occasioned usually by direct violence.

TREATMENT. Aside from clipping badly traumatized tissue away and cauterizing with mercurochrome, iodine, or any recognized antiseptic solution, the treatment is the same as in simple fractures. All skin edges are sutured with fine horsehair, which *should be removed in three days to avoid scars*. When internasal splints cannot be

obtained a careful mercurochrome packing can be introduced into both nostrils to distend them and small wooden splints from throat sticks can be fitted to each side of the nose with adhesive or collodion.

COMPLICATIONS. Infections, whether present or developing, must be treated according to condition. However, if the initial care is thorough these should not develop.

PROGNOSIS. There should be no disability, although two to three weeks of surgical care will be necessary.

Occasionally, where the nasal passages are not properly protected and molded, it will be necessary later to do a resection of the septum. This should be done when possible by one specializing in the subject. Sometimes an examination by this specialist shows a congenital defect which the injured man is trying to hold due to injury, and expert opinion will eliminate this responsibility.

FRACTURE OF THE JAW

THE UPPER MANDIBLE

The upper mandible, with the exception of the alveolar process, is seldom fractured, and when this occurs the fracture is almost always associated with a fracture of the lower mandible. It occurs usually by direct trauma.

SYMPTOMS. These are bleeding, loose teeth, sometimes a complete absence of some teeth, with raw, bleeding root cavities. When the injury involves the malar bone with depression it is objectively noticeable. Roentgenograms will sometimes confirm the diagnosis.

TREATMENT. Remove all loose teeth, but do not attempt to correct any bone depression until the mouth has been rendered as clean as possible, as there is danger of carrying infection up into the cleaner passages. Paint root cavities with mercurochrome solution, then mold the gums and give the patient a mouth wash of some kind. I recommend 2 dr. of Fowler's solution to 4 oz. of water, used three to four times a day. I have found that this solution will do more than any other preparation to prevent post-traumatic infection.

THE LOWER MANDIBLE

Evidence of simple fracture is by history of trauma, localized swelling, pain, muscle spasm, lack of apposition of lower jaw,

occasionally loose teeth, bleeding and crepitus. The latter can best be obtained by holding the patient's head against one's chest with the left hand, and, with the forefinger of the right hand inside the mouth and the thumb outside, using lateral manipulation. Roentgenograms are confirmatory. Sometimes one view of a jaw will not show a fracture, so if necessary more than one view should be taken.

TREATMENT. Remove all loose teeth. Before doing this, however, providing there is an external compound wound, *do your débridement of the external tissues*, thoroughly cauterize with mercurochrome or some such solution and close with a fine suture. I recommend a fine suture, such as horsehair, because the entire face is sensitive, heals very rapidly and is subject to effects of trauma. For these reasons any suture introduced into the face should be removed *not later than the third day*, in order to avoid a scar.

Do not work first in the mouth and then on the external wound, because thus you are bound to carry infection from the mouth to the external wound. For that reason *finish the outside work first*. After this is done remove all loose teeth and use mercurochrome in open tooth cavities.

Following that, wire the lower to the upper teeth, being sure to follow the normal alignment of that particular case. Practically no two cases are alike; one person's lower jaw fits anterior to the upper, another posterior to it, another may fit tooth for tooth. Do not try to fit the lower jaw of a patient to the upper jaw as you would like to see it, but consult that patient as you go along, in which event you will find the question of reduction much easier. In other words, the muscle balance which has existed over a number of years in a jaw, plus teeth formation, is much easier to meet than to attempt to change, and I find that, as a rule, the patient prefers to have the condition as it was before the injury.

When one can obtain the services of an oral surgeon, and financial conditions will permit it, it is just as well to let him handle the situation.

However, in view of the fact that almost all these fractures are compound, one should insist upon the use of a mouth wash consisting of 2 dr. of Fowler's solution to 4 oz. of water. This is the only solution I have been able to find that approaches the elimination of infections of the mouth. I have had compound fractures of the lower

jaw where two to three inches of the bone were exposed inside the mouth and yet the use of this Fowler's solution prevented infection and a prolonged osteomyelitis.

It is always advisable where interdental splints for holding the jaw are used, to employ a Barton's head bandage also, feeding the patient liquids through a rubber tube. As a rule this must be continued for at least four to five weeks.

COMPLICATIONS. Complications are osteomyelitis and non-union.

PROGNOSIS. Disability in clean cases is from eight to twelve weeks, in infected cases indefinite.

CHAPTER IV

TRAUMATIC ARTHRITIS OF THE SHOULDER WITH ULTIMATE FIBROSIS

THREE are two forms of traumatic arthritis: (1) intracapsular and (2) extracapsular. Both forms are the result of either direct or indirect injury: falling on the outstretched arm, dislocation, fracture, prolonged immobilization, etc. The condition is characterized by an inflammation of the capsule of the shoulder joint and the surrounding musculature.

Traumatic arthritis is aggravated and prolonged by focal conditions such as bad teeth or tonsils. Thorough physical examination and routine laboratory tests are essential in cases of this type, and treatment of any focal infection may be of considerable indirect help in clearing up the arthritic condition.

INTRACAPSULAR TRAUMATIC ARTHRITIS OF THE SHOULDER

SYMPTOMS. This type is characterized by pain about the shoulder joint, and, when the head of the humerus is rotated, pain within the joint. There is inability to abduct the arm beyond a horizontal line; also difficulty in lowering the arm, in which there is definite muscle spasm, and the patient is unable to lower his hand to the side of the body, or to turn it behind the body, without pain.

Pressure over the long head of the biceps (Fig. 29) produces pain, because anatomically the long head of the biceps enters the capsule of the shoulder joint and arises from the supraglenoid tubercle of the scapula.

TREATMENT. As long as pressure over the long head of the biceps causes pain, this type should be left alone so far as manipulation is concerned. To eliminate pain the arm should be placed in a sling, at rest. Heat and local applications are advisable. Massage only increases the irritation. Internal medication and elimination of any focal infection will prove helpful. After all pain has subsided, a month or six weeks, occasionally even two months, should elapse before wrenching of the shoulder is undertaken. Cessation of pain is followed by definite fibrosis of the shoulder joint. This fibrosis



FIG. 29. Point of tenderness on pressure in intracapsular fibrosis of the shoulder joint

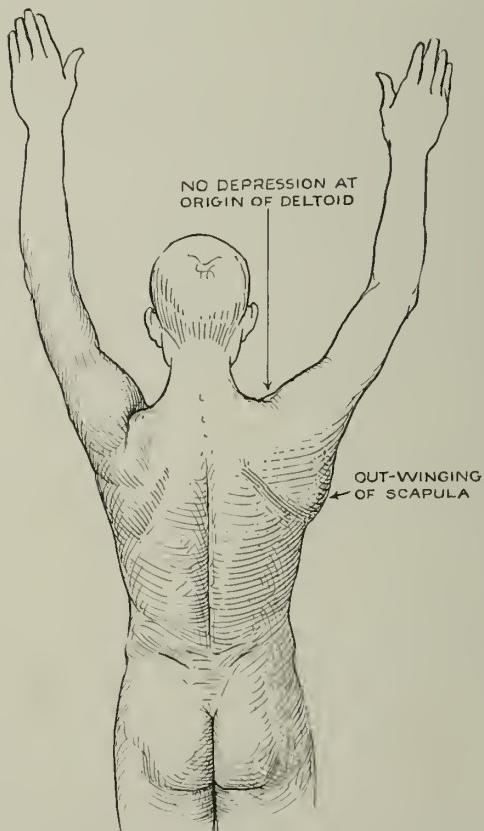


FIG. 30. Definite test to determine scapulohumeral fibrosis.

is indicated by the fact that when an attempt is made to raise the arm above the horizontal, the scapula moves with the head of the humerus. As the fibrosis develops the scapula moves more and more



FIG. 31. Partial fibrosis of shoulder with limitation in elevation. Note loss of normal depression over left deltoid.

with the humerus and the usual deltoid depression, seen from behind at the junction of the scapula with the humerus, is obliterated (Fig. 31).

In all patients over forty years of age, traumatic injuries of the shoulder, even in the absence of fracture or dislocation, are quite likely to cause fibrosis. Abduction is therefore always the position of choice for treatment.

Wrenching of the Shoulder. Wrenching of the shoulder should then be performed under complete anesthesia. It requires two people. The operator grasps the humerus high up, close to the scapulo-humeral joint, and carries out the motions gradually in order not to risk fracturing the humerus. The accompanying photographs (Figs. 32 to 35) show how these motions should be performed. While the operator is carrying out the manipulations, the assistant keeps the thenar eminence of his hand on the outer border of the patient's shoulder blade.

At the completion of the operation, the deltoid depression (Fig. 31) will have reappeared. The operator should then draw both the patient's arms above his head to make sure that the deltoid depression of the affected side is symmetrical with that on the normal side of the body.

Postoperative Treatment. The affected arm should be kept above the patient's head after the operation and the patient removed from the anesthetic room to his bed in this position. When he is placed in



FIG. 32.



FIG. 33.



FIG. 34.



FIG. 35.

Figs. 32-35. Manipulation for release of fibrosis of shoulder joint, showing manipulation necessary to gain full range of shoulder motion. Assistant's hand is held strongly against scapula.

bed the arm should be attached to the head of the bed and kept raised above the patient's head for thirty-six to seventy-two hours, preferably the latter. At the end of this time the arm can gradually be brought down to the patient's side. Passive and active movements, including massage, should then be practiced for ten days to two weeks, in order to overcome muscular soreness and eliminate the possibility of a permanent fibrosis.

A simple device for use at home is a pulley rigged up over a doorway, with a rope run through, to one end of which is attached a 5 lb. weight. At the other end should be a loop which can be grasped by the patient, as he pulls the weight up and then lets the weight pull the arm up (Fig. 36).

Three weeks and occasionally more must elapse after the wrenching before the patient can return to work. The massage may be continued with advantage for another two weeks.

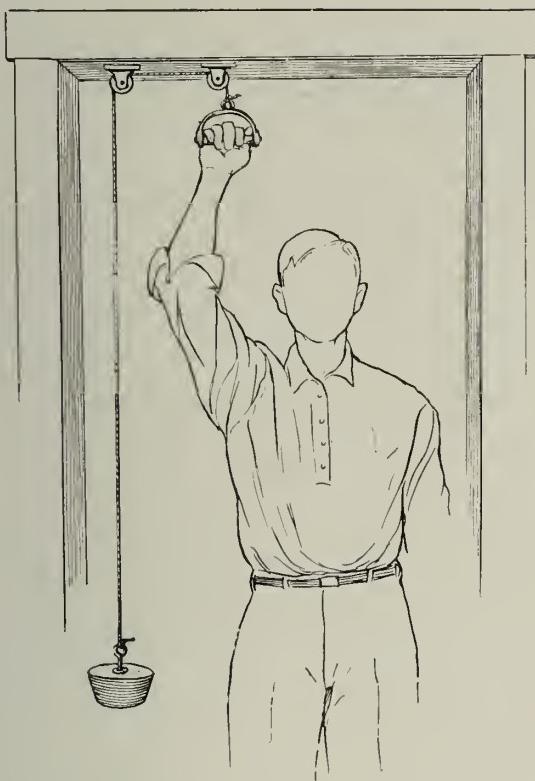


FIG. 36. Simple method of regaining scapulohumeral motion by patient's own efforts.

PROGNOSIS. The prognosis must be guarded in this form of injury. Manipulative treatment takes from two to three months, depending upon the severity of any focal infection; and postoperative treatment will require a month or more. The period of disability should be estimated at about five months.

In poorly nourished people in whom the complete elimination of focal infections is impossible one must consider the possibility of refibrosis of the shoulder.

COMPLICATIONS. Be careful in the intracapsular type of case not to wrench too soon. Be sure that all pain has left the long head of the biceps and has been absent for at least six weeks to two months. Otherwise, if you wrench while the inflammation is still present, the fibrosis will recur.

EXTRACAPSULAR TRAUMATIC ARTHRITIS OF THE SHOULDER

SYMPTOMS. In this type the deltoid muscle and its nerve supply are affected by the arthritis. There is pain over the curve of the shoulder, following the course of the deltoid to its insertion and occasionally to the elbow. Usually by the time these patients present themselves they have already developed a fibrosis of the shoulder.

TREATMENT. In the fibrotic cases of this type, unlike those of the intracapsular type, it is unnecessary to wait for the entire subsidence of pain before wrenching the shoulder. The wrenching is accomplished in exactly the same way as in the intracapsular type (p. 48). The after-treatments are identical, but as a rule, massage need not be continued as long in the extracapsular as in the intracapsular cases.

In the cases in which fibrosis has not yet developed, it is advisable to treat the inflammatory muscular condition until it has become a fixed fibrosis and then wrench the shoulder. Occasionally, however, no fibrosis at all will develop and by means of massage, heat, diathermy, etc., the soreness may be removed and motion restored.

PROGNOSIS. The prognosis is essentially the same as in the intracapsular type. It must be a guarded one because of the possible influence of such focal conditions as bad teeth or tonsils. In some of these cases, however, the disability period of about five months may be shortened somewhat, since one does not have to wait for the complete subsidence of pain before wrenching the shoulder, or carry on postoperative massage for such a long period as in the intracapsular type.

CHAPTER V

FRACTURE OF THE CLAVICLE

DIAGNOSTIC TEST. The symptomatology of fracture of the clavicle is so well known that details are unnecessary. The condition may be diagnosed by a very simple test (Fig. 37), confirmed, as a matter of record, by the roentgenogram: The physician need only stand behind the patient, place the fingers of one hand at the proximal attachment of the clavicle and the fingers of the other hand at the distal end, and by gentle manipulation determine any preternatural mobility and bone crepitus. This, together with a drooping of the affected shoulder, will suffice for diagnosis.

Value of Diagnostic Test in Determining Bony Union. Not only is this simple test practical in determining the presence of a recent fracture, but also it is of value if, after treatment, there is any controversy as to whether bony union has taken place. If bony union has occurred, there is no movement at the point of fracture, all movement taking place in the articulations. In many controversial instances, even with the roentgen ray as an assisting factor, this simple test is the only means of determining bony union.

TREATMENT. The Valentine Splint. The treatment of fracture of the clavicle is simple, and consists in the application of a splint devised by Dr. James A. Valentine of Chicago. This splint consists of a leather pad and straps. Both the splint itself and the method of applying it are shown in the accompanying illustration (Fig. 38). There is one point which must be especially emphasized in its application: The strap which passes over the point of the shoulder on the affected side should be placed on the extreme outer end of the shoulder and should be held in position by two or three adhesive strips which are applied only after the shoulder has been drawn back thoroughly and the abdominal strap tightened (Fig. 38). If this splint is properly applied and the position intelligently maintained, with very special attention to the adjustment of the strap passing over the extreme outer end of the shoulder, excellent alignment will be achieved without discomfort to the patient. Since this splint does not immobilize the arm, motion in the elbow and forearm can be started as early as the second week of treatment, and

such motion will tend to avoid any loss of function and cut down the disability.

Advantages of the Valentine Splint. This splint is more effective



FIG. 37. Examining for ununited or recent fracture of clavicle by standing behind the patient.

than the Velpeau, Sayre and other dressings in maintaining reduction and bringing about obliteration of the deformity. The Valentine splint also causes less pain than fixed dressings, such as those of Sayre and Velpeau. I have found that when I have put fixed dressings upon a well-developed, muscular workman, the circulation of the elbow has been interfered with to such an extent that, six to eight hours after application, the excruciating pain in elbow and forearm has made it necessary to remove the dressing.

Open Operation on the Clavicle. An open operation is indicated only when there is a possibility that a fragment of bone which has broken off and has become displaced transversely to the longitudinal axis may compound externally by pressure necrosis, or involve

blood vessels and nerves underneath. In such cases, simple removal of the fragment and realignment of the fractured ends and temporary fixation by such means as a kangaroo tendon are sufficient.

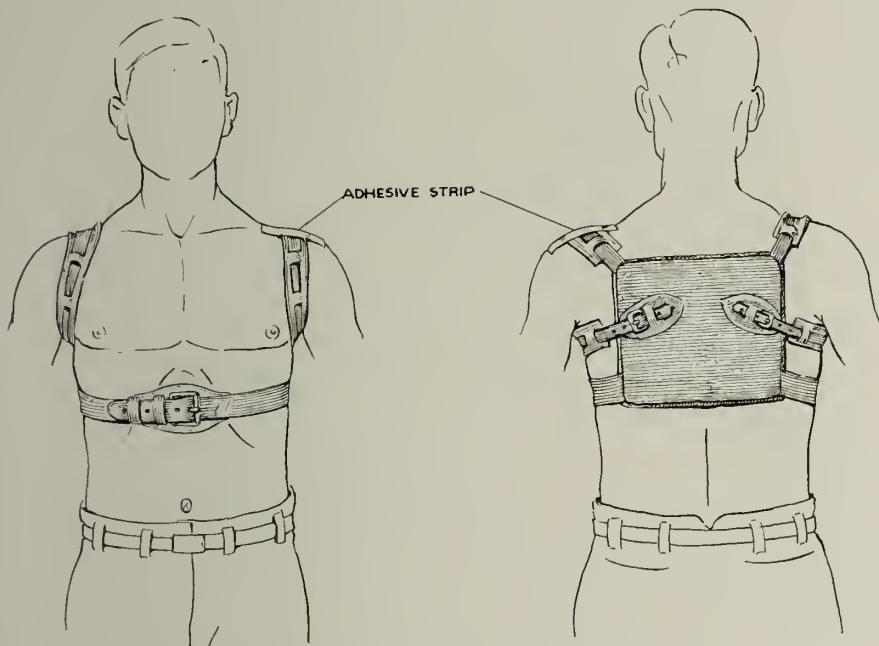


FIG. 38. Valentine's splint for fractured clavicle.

Any attempt to wire or plate the clavicle is certain to meet with disaster, since this bone cannot be immobilized because of the continual expansion and contraction of the chest wall during inspiration and expiration. Fortunately, the clavicle and the ribs, as surprisingly few doctors realize, heal more rapidly and are less subject to non-union than any other bones in the body, in spite of the impossibility of immobilizing them. Any foreign material applied to the clavicle will inevitably work loose and require removal; and very often it will cause bone necrosis or osteomyelitis, with a prolonged suppuration. Furthermore, one should not expect an end-to-end union of the clavicle. It just does not occur. Surgeons occasionally operate thinking they must get an end-to-end approximation. This is a great mistake. The ends should be let alone. They

almost always develop an overriding union with absolutely no interference with function.

Position of Patient during Early Treatment. For ten days or two weeks after the injury the patient should rest only in a sitting position or Fowler's position. A horizontal position in bed increases the danger of a passive congestion of the lungs or possibly traumatic pneumonia.

COMPLICATIONS. Occasionally there is a traumatic arthritis of the shoulder, particularly in the older person who has an oral sepsis or a rheumatic tendency. Otherwise there should be no specific loss.

PROGNOSIS. Disability in these cases extends over a period of eight to twelve weeks. There need be no permanent loss of function because, as Valentine's splint does not immobilize the arm, motion in the elbow and forearm can be started as early as the second week of treatment.

CHAPTER VI

INJURIES OF THE SCAPULA AND HUMERUS

FRACTURE OF THE SCAPULA

THIS injury in civil life, where occupational conditions are not found, is rather uncommon, but among the trades it is not unusual. I have come in contact with a number of such fractures and will try to show the two methods which we follow in treating them.

The first type is that of simple, multiple or comminuted fracture such as is shown in Figure 39, wherein the glenoid fossa is not involved. In this type one does not fear a joint involvement.

SYMPTOMS. The history is of a fall, striking the posterior area of the shoulder direct, or of some object falling directly on the shoulder. This is followed by possible swelling, occasionally redness, very seldom ecchymosis, muscle spasm upon attempted motion, definitely restricted action of arm, shoulder joint and scapula, and very seldom crepitus. A roentgenogram, *if clear*, will definitely show the fracture. Where the film clearly shows no involvement of the scapulohumeral joint, the treatment is as follows:

TREATMENT. For the first seventy-two hours a Littler-Jones splint is advisable, until the extreme tenderness and spasm have subsided. Following this the arm can be carried in a sling and each day passive massage and motion can be used as tolerated, or even a little beyond toleration. This can be gradually increased every other day until full shoulder girdle motion is acquired.

PROGNOSIS. Disability will be two to three months without any specific loss.

FRACTURE OF THE SCAPULA INVOLVING THE SCAPULOHUMERAL JOINT

The causal factors here will be approximately the same as just described. Some writers claim dislocation as a cause but I have never seen it.

SYMPTOMS. Symptoms are the same identically as in fracture without involvement of the joint, except that the spasm and limitation of shoulder girdle motion will be increased and prolonged.



FIG. 39. Multiple fracture of scapula not involving joint and eliminating necessity of prolonged immobilization of shoulder. Compare Figure 40.



FIG. 40. Fracture of scapula showing joint involvement where Littler-Jones abduction splint is highly applicable. Compare Figure 39.

INJURIES OF SCAPULA AND HUMERUS

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TREATMENT. This must be considered from an entirely different standpoint. With the hemorrhage and effusion in and about the articulation one must realize that there is bound to be a definite

FIG. 41. Fracture record of case shown in Figure 40.

change in the way of tissue and cicatricial formation which will embarrass the joint motion. Hence the question of *position of choice* is all-important. For that reason see Figures 40 to 43, which show an injury calling for the use of some form of abduction splint which permits us to put the arm in the position of choice, namely, abduction with the arm on a level with the shoulder, the arm *pointing forward on a line with the face as shown in Figure 49.*

When this type of fracture is diagnosed and the splint applied (if possible, immediately), it should be allowed to remain in position for at least four to six weeks. If dropped too soon adhesions will form producing some limitation of abduction.



FIG. 42. Fracture of coracoid process of scapula in which it is advisable to use Littler-Jones splint.

FRACTURE RECORD					
Name	R.C.	Address	518 HIGHLAND AVE. OAK PARK	Case No.	67647
Age	44	Sex	M.F.	Date	Hr.
Occupation	CARPENTER			Dr.	
Cause of Fracture FELL 9 FEET, STRIKING STAIRWAY WITH RIGHT SHOULDER				Time of Occurrence of Accident 2-22-26	
				Hospital Entered	
				First Treatment	
				Final Reduction	
X-Ray No. 26911					
EXAMINATION		TREATMENT		RESULT	
Bone R. SCAPULA		Closed Reduction YES		Anatomical Functional	
Site CORACOID AND ACRONION PROCESSES		Method and Position of Plaster		<input checked="" type="checkbox"/> Good <input type="checkbox"/> Moderate <input type="checkbox"/> Bad	
Type:		JONES' ABDUCTION splint		<input checked="" type="checkbox"/> X <input type="checkbox"/> <input type="checkbox"/>	
Simple	Transverse	Anesthetic Used	Yes	No	
Compound	Obligate	Anatomical Result obtained			
X into Joint	Spiral	(a) At discharge from Hospital Date			
Schroterginal	Impacted	BRACE REMOVED 3-15-26			
Greenstick	Comminuted	Open Reduction			
Method and Position of Plaster					
Description of Deformity (including shortening)					
PHYSIOTHERAPY BEGUN 3-22-26					
(b) At discharge from C.P.D. Date EXCELLENT RANGE OF MOTION IN SHOULDER					
SOME MUSCULAR WEAKNESS					
Anatomical Result obtained					
Nature and Extent of Injury to Soft Parts especially nerves and vessels					
(c) At subsequent date Date					
CONTUSION					
Was non-operative treatment tried first?					
Disability: Absent, Partial, Complete					
How long after injury was operation performed?					
Was internal fixation material subsequently removed?					
X-Ray					
Why					
Mortality Date					
Before Reduction When					
Male cause of death					
After Reduction Period of Complete Immobilization					
Absence from work: Duration ABOUT 43 WEEKS					
At Discharge Period of Protection					
Ability to resume job					
Waasermann Test Total Period of Protective Treatment					
*Present Wage earning capacity					
NOT DONE Compensation obtained: Yes? No?					
Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion					

Form 19 (A. G. S. Case Record System)
Faith First Company, Chicago

FIG. 43. Fracture record of case shown in Figure 42.

During this time the arm can be raised out of the splint after the first week about two to three times a week, and as the pain and muscle spasm disappear, oftener and higher.



FIG. 44. Intracapsular fracture of head of humerus.

COMPLICATIONS. On both types of scapula fracture, traumatic arthritis either intrascapular or extrascapular is likely to follow (Chapter IV).

PROGNOSIS. Disability is three to four months, and there should be little or no specific loss if properly handled.

IMPACTED FRACTURE OF THE ANATOMICAL NECK OF THE HUMERUS

Impacted fracture of the anatomical neck of the humerus can seldom be recognized by visible deformity. The injury must be diagnosed by the symptoms of diffuse pain through the head of the shoulder joint, muscle spasm and restricted motion of the joint. Seldom if ever is crepitation found, except in the aged. The diagnosis should be confirmed by roentgenograms.

TREATMENT. In this fracture no real reduction is made because the surgeon does not break up the impaction unless he is forced to change the alignment in order to improve the function and this is



FIG. 45. Application of Littler-Jones abduction splint for intracapsular fracture of head of humerus.



FIG. 46. Anteroposterior view, showing proper position of upper arm pointing toward front of body instead of out from side



FIG. 47. End-result following use of Littler-Jones abduction frame shown in Figures 45 and 46. (See chart, Fig. 48.)

INJURIES OF SCAPULA AND HUMERUS

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rare. Particular attention should, then, be paid to the position of the arm in the splint: *abduction of the arm on a level with the shoulder, with the elbow pointing straight out in front of the body* (Fig. 46).

FRACTURE RECORD					
Name J. V.	Address	Case No. 59108			
Age 57 Sex M	M. S.W.O.	White	Date Hr.		
Occupation GRAIN TRADER			Dr.		
Cause of Fracture FELL ON FLOOR AFTER TRIPPING					
		X-Ray No. 27453			
EXAMINATION		TREATMENT	RESULT		
Bone RIGHT HUMERUS		Closed Reduction YES	Good	Moderate	Bad
Site		Method and Position of Fixation JONES ABDUCTION			
Type:		SPLINT CARRYING ARM WELL FORWARD			
Scapula Transverse		Anesthetic Used Yes No			
Compound Oblique		Anatomical Result obtained SPLINT WORN ABOUT			
Intra Joint Spiral		SIX WEEKS. SINCE THAT TIME			
Subarticular Impacted		PHYSIOTHERAPY AND EXERCISE TO IN-			
Greenstick Comminuted		Other Protection CREASE RANGE OF ABDUCTION			
Description of Deformity Including shortening		Method and Period Immobilization ABLE TO ABDUCT ARM			
INTRACAPSULAR FRACTURE OF RIGHT HUMERUS.		TO 135 DEGREES.			
Nature and Extent of Injury to Soft Parts <small>muscles, nerves and tendons</small>		Anatomical Result obtained			
			(a) At discharge from Hospital Date 10-19-26		
			LIMITATION 10 DEGREES IN FULL ELEVATION, APPARENTLY 25% OF INTERNAL ROTATION. FUNCTIONAL LOSS 10% OF ARM.		
X-Ray		Was non-operative treatment tried first?			
Before Reduction		How long after injury was operation performed?			
After Reduction		Was internal fixation material subsequently removed?			
At Discharge		Why		Mortality	Date
Wassermann Test		When		Method cause of death	
		Period of Complete Immobilization		Absence from work: Duration	10 WEEKS
		Period of Protection		*Ability to resume job	
		Total Period of Protective Treatment		*Present Wage earning capacity	
				Compensation obtained: Yes? No?	
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 19/A.C.S. Case Record System
Futura Company, Chicago

FIG. 48. Fracture record of case shown in Figures 44-47.

I wish to emphasize for several reasons the importance of bringing the arm to the front of the body in preference to placing it at a right angle. Should a fibrosis of the shoulder joint develop, which cannot be overcome and which results in a permanent ankylosis, the position shown in Figure 46 allows the scapula to protrude and slide by the spine, thus permitting the arm to drop to the side of the body. If, however, ankylosis develops while the arm is held at a right angle to the body, the patient will not be able to bring the arm in contact with the body when he attempts to drop it to his side, but must hold it abducted at an angle of 20° to 40°, a very awkward and uncomfortable position.

Another advantage of bringing the arm to the front of the body concerns the breaking down of possible adhesions. Naturally a

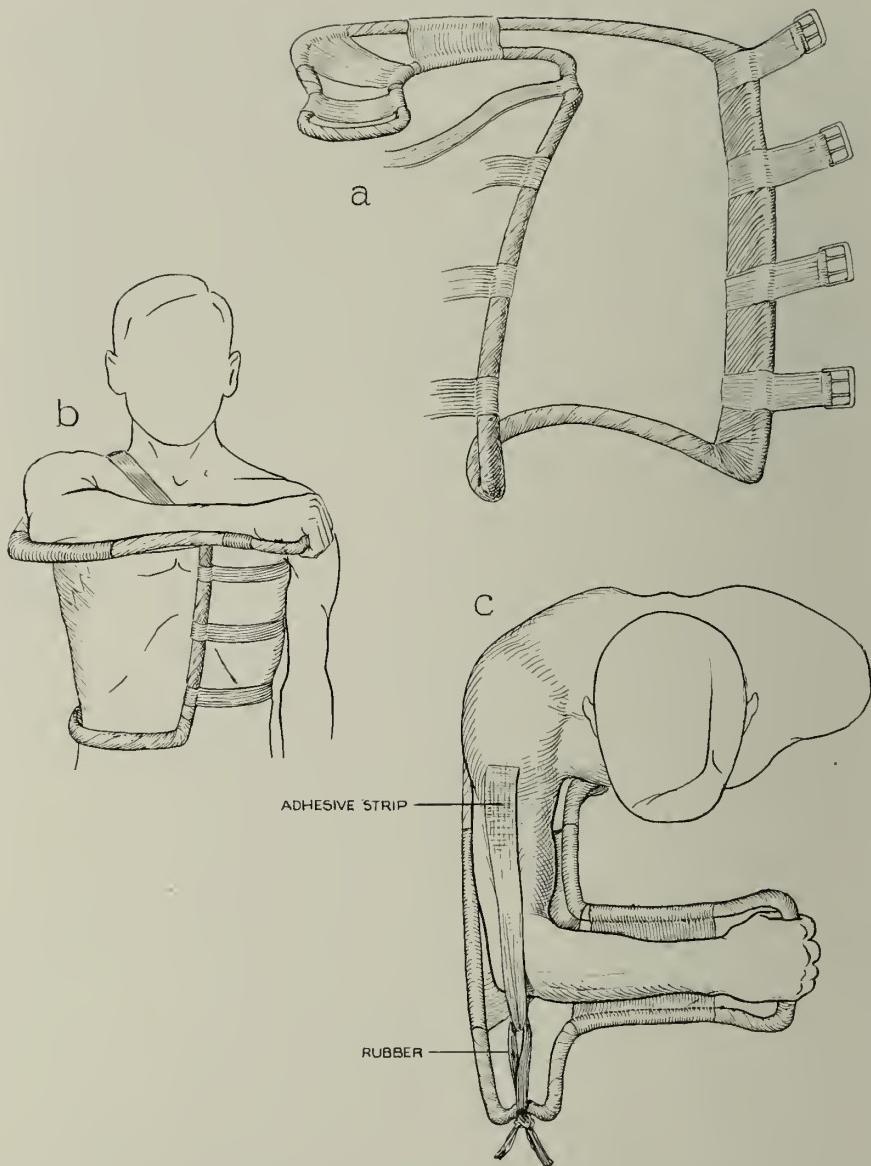


FIG. 49. Proper position of abducted arm, also method of applying traction in fractures of humerus from upper middle third down.

fracture of the anatomical neck of the humerus involves not only the outer structures but also the capsule of the shoulder joint, and causes a temporary inflammation. Contraction follows and cicatrices



FIG. 50. Old unreduced dislocation surgically reduced. Treated in a Littler-Jones abduction splint. Later fractured at surgical neck and again treated in same manner. Shows bony ankylosis of scapulohumeral joint. Figures 51-53 show end-result.

develop, which limit the action of the shoulder joint. If the arm is placed in front of the body, adhesions are broken down by the natural weight of the arm, with much less discomfort to the patient and with better results from any efforts to regain motion. With the arm brought to the front of the body, passive massage and abduction can be given about the shoulder without removing the splint in from ten days to two weeks following injury.

The most practical splint I have been able to find for this fracture is the Littler-Jones abduction splint (Fig. 49). In the illustration

there is noticeable a change which I have made in the splint. I have found it practical not only in this particular injury but also in fractures of the surgical neck, and of the shaft of the humerus



FIG. 51.



FIG. 52.



FIG. 53.

Figs. 51-53. Range of motion obtained in ankylosed shoulder joint by compensatory scapular motion when treated in Littler-Jones abduction splint.

down to about the center of the middle third. This change consists in putting an extension on the splint at the elbow, which extends some 6 to 8 inches beyond, permitting the application of extension apparatus such as moleskin to the arm, and, by tying onto the

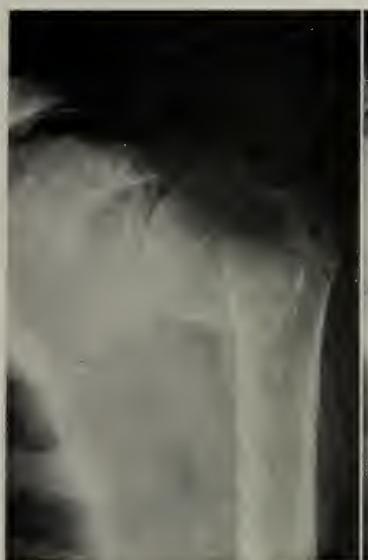


FIG. 54.



FIGS. 54 and 55. Fracture of neck of left humerus.

FRACTURE RECORD

Name	C. J.	Address	Case No.	80742						
Age	59	Sex	Date							
Occupation	BRICKLAYER	White or Colored	Dr.	FORRESTER						
Cause of Fracture			Time of Occurrence of Accident							
FELL 5 FEET L. NLING ON CONCRETE FLOOR			MAY 11, 1927							
			Hospital Entered							
			First Treatment	JUNE 7, 1927						
			X-Ray No.	31511						
			Final Reduction							
EXAMINATION		TREATMENT		RESULT						
Bone HUMERUS, LEFT		Closed Reduction		<table border="1"> <tr> <td>Good</td> <td>Moderate</td> <td>Bad</td> </tr> <tr> <td>X</td> <td></td> <td></td> </tr> </table>	Good	Moderate	Bad	X		
Good	Moderate	Bad								
X										
Site NECK		Method and Position of Fixtures ADDUCTION ARM FIXED AT BODY		<table border="1"> <tr> <td>Anatomical</td> <td></td> </tr> <tr> <td>Functional</td> <td>X</td> </tr> </table>	Anatomical		Functional	X		
Anatomical										
Functional	X									
Type		Anesthetic Used Yes No		Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve						
X-Style	Transverse			(a) At discharge from Hospital Date						
Cervical	Oblique			CAME UNDER OUR CARE AFTER ONE MONTH						
Int. Joint	Spiral									
Subcortical	X Imected									
Grooves	Comminuted									
Description of Deformity including shortening		Open Reduction-								
PROTRUSION AT HEAD OF RADIUS TO		Method and Position of Fixtures -								
PALPATION.		COMPLICATED BY COLLES' FRACTURE		(b) At discharge from O. P. D. I. Date 10-3-27						
		IN SAME ARM.		UNION FIRM, NO ATROPHY.						
		Assessments Report obtained:		ELEVATION OF SHOULDER 110 DEGREES.						
		HEAT AND MASSAGE BEGUN AT END OF FOUR		ROTATION OF SHOULDER SLIGHTLY LIMITED.						
Nature and Extent of Injury to Soft Parts <small>muscles, nerves and vessels</small>		WEEKS		HAND TO BACK OF HEAD.						
ATROPHY OF SHOULDER MUSCLES, DELTOID				(c) At subsequent date Date						
MORE OBVIOUS.				Disability: Absent, Partial, Complete						
X-Ray				25% LOSS OF FUNCTION OF ARM.						
Before Reduction, SOME ANGULATION AND ROTATION.		When		Mortality Date						
After Reduction		Period of Complete Immobilization		Main cause of death						
At Discharge GOOD CALLUS.		4 WEEKS		Absence from work: Duration						
Wassermann Test		Period of Protection		*Ability to resume job						
		5 WEEKS		*Present Wage earning capacity						
				Compensation obtained: Yes? No?						
<p><small>*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion</small></p>										

Form 194-C. C. S. Case Record System
Health Service Division

FIG. 56. Fracture record of case shown in Figures 54 and 55.

extension, an opportunity to prevent overriding, at the same time securing alignment.

As a rule, the physician is not supplied with this form of splint.



FIG. 57. Referred case of gun-shot wound of shoulder where abduction treatment was not carried out. End-result complete abduction, through scapulohumeral compensation.

He may then use a plaster abduction splint, or any other appliance which will give the same result as the Littler-Jones splint. If necessary, the patient can be placed in bed, a modified Balkan frame used and the arm suspended over the head in the same line as that brought out by the splint. The Littler-Jones splint, however, prevents hospitalizing the patient.

The Littler-Jones splint can be worn indefinitely with comfort. It should be left on for at least five to eight weeks. At the end of one to two weeks passive massage can be given about the shoulder, without removing the splint.

When the splint is finally removed, a sling can be used and massage should be continued in order to prevent fibrosis. In addition, exercises should be given, such as that shown in Figure 36, the arm being carried upward by means of a counter-weight, rope and pulley.

PROGNOSIS. The disability should last three to four months, provided the method of treatment is similar to that just described.

If the arm is treated in adduction or brought to the side of the body, the disability period is twice as long, and may be further lengthened by the complication of a scapulohumeral fibrosis. One must also consider the possibility of circumflex paralysis or traumatic arthritis.

FRACTURE OF THE SURGICAL NECK OF THE HUMERUS

These fractures are so seldom impacted that they can be easily diagnosed by distortion, preternatural mobility, extreme pain and crepitation. The roentgen ray serves to confirm the diagnosis.

TREATMENT. The treatment consists of abduction with traction either at right angles to the body or, preferably, in front of it, as in treatment of fracture of the anatomical neck of the humerus. In fractures of the surgical neck, when a Littler-Jones splint cannot be obtained, a short Thomas splint, with traction and hyperabduction, can be used (see Fig. 345).

If a Littler-Jones splint, with elbow modification, is used, the patient can be treated at home, visiting the physician at his office; but, if the short Thomas splint is used, the average patient insists on hospitalization. The splint should be left on for eight to twelve weeks, or possibly longer, depending upon the rate of formation of callus. Passive and active massage should follow removal of the splint.

PROGNOSIS. Disability will last from four to six months. In cases complicated by such conditions as scapulohumeral fibrosis, non-union, focal infections, etc., the period of disability may be considerably increased.

FRACTURE OF THE SHAFT OF THE HUMERUS

Fractures of the shaft can be diagnosed by distortion, preternatural mobility, crepitation, pain, swelling, ecchymosis and muscle spasm. Roentgenograms will confirm the diagnosis.

TREATMENT. The modified Littler-Jones splint or a cast with our elbow splints is used in these cases; but if neither is available, the Thomas splint (see Fig. 345) or one such as described by Scudder,* or a plaster cast, can be employed. The plaster cast, in the absence of a Littler-Jones or Thomas splint, helps to align the

* Scudder, C. L. *The Treatment of Fractures*. Ed. 10. Saunders, Phila., 1926, p. 282.

bone, and also by its weight, as it hangs by the side, acts as a mechanical means of traction. One should be careful in using plaster not to get it too heavy, as an excess of weight may separate the



FIG. 58. Spiral fracture, middle and lower third of humerus, using plaster cast and later on, elbow splints for extension and early motion.

FIG. 59. Roentgenogram of same case as Figure 58, seven months later. No nerve involvement, and 100 per cent function.

ends of bone and reproduce non-union. Intermittent roentgenograms will aid in preventing such an occurrence.

Immobilization must be continued for six to eight weeks and occasionally longer, depending on the rate of formation of callus, as shown by the roentgenogram and by manipulation. After the splint or cast is removed heat, massage and diathermy should be employed for six to eight weeks.

COMPLICATIONS. Musculospiral Nerve Involvement. The musculospiral nerve runs in a groove on the outer side of the humerus, about 10 cm. above its outer condyle. If a fracture involves the middle and lower thirds of the humerus, one should keep in mind the possibility of danger to this nerve, either by direct injury at the time of fracture or by involvement of the nerve with the forming callus.

Should neural symptoms appear, operation upon the musculospiral nerve should be delayed for five or six weeks after the initial treatment of the fracture. This nerve recovers very quickly, so that the delay need not prolong the period of disability unless a suture is performed. An early double operation of repairing both the bone

and the nerve causes much trauma and accounts for many cases of infection. It is very difficult, and is likely to result in joint fibrosis and failure of the nerve to regenerate. Moreover, I have seen some



FIG. 60.

FIG. 60. Fracture of scapula involving joint, and multiple fracture of lower end of humerus involving musculospiral nerve.

FIG. 61. Same case after surgical intervention, removing nerve from fracture, using middle fragment of bone as intramedullary peg, treating shoulder and fracture in Littler-Jones abduction splint. (See chart, Fig. 62.)



FIG. 61.

very bad results following early surgical intervention in which some method of bone fixation, such as a Lane plate, was employed. On the

IMPERATIVE TRAUMATIC SURGERY

other hand, following the single operation of reduction of the fracture, any nerve impingement may cease at once, and all nerve symptoms promptly subside.

FRACTURE RECORD					
Name	R.C.	Address	DUNDEE, ILLINOIS	Case No.	73233
Age	30	Sex	M	Date	Mr.
Occupation	GRAVEL WASHER			Dr.	FORRESTER & EICHLER
Cause of Fracture	SAND SHOT FELL STRIKING HIL ON RIGHT SHOULDER AND ARM.			Time: Occurrence of Accident	8-27-26
				Hospital Entered	
				First Treatment	
				Final Reduction	
EXAMINATION		TREATMENT		RESULT	
Bone	HUMERUS, LEFT	Closed Reduction		Good	Moderate
Site	LOWER HALF	Method and Position of Fixation	ABDUCTION	Bad	
Type:				X	X
Simple	Transverse	Anesthetic Used	X Yes		
X Compound	Oblique	Aesthetical Result obtained			
Into Joint	Axial	FAIR			
Subperiosteal	Impacted				
Greeneck	X Comminuted	Open Reduction	10-18-27		
Description of Deformity Including shortening		Method and Position of Fixation	REMOVAL SEGMENT BONE,		
MARKED DEFORMITY,			INTERMEDULLARY GRAFT,		
LACERATED WOUNDS ABOUT NECK, SHOULDER AND			DISSECTION RADIAL NERVE,		
ARM,					
Nature and Extent of Injury to Soft Parts especially nerves and vessels					
OEDEMA, LOSS RADIAL NERVE, PARTIAL LOSS		Was non-operative treatment tried first?	YES		
MEDIAN AND Ulnar, LOSS RADIAL PULSE.		How long after injury was operation performed?	7 WEEKS		
		Was internal fixation material subsequently removed?	NO		
X-Ray		Why		Mortality	Date
Before Reduction	LOSS SEGMENT HUMERUS.		When	Main cause of death	
After Reduction		Period of Complete Immobilization	CAST 6 WEEKS	Absence from work	Duration
At Discharge		Period of Protection	9 $\frac{1}{2}$ MONTHS	*Ability to resume job	POOR
Wassermann Test		Total Period of Protective Treatment	11 MONTHS	*Present Wage earning capacity	
				Compensation obtained	Yes? NO?
<small>*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion</small>					

Form 191-A C & Case Record System
Aetna Casualty, Chicago

FIG. 62. Fracture record of case shown in Figures 60 and 61.

Furthermore, if the surgeon attempts to repair the injured nerve at the time of injury, he will find that it is very difficult to maintain the relative position of nerve and bone. After five or six weeks sufficient callus lies about the site of fracture to maintain the position of the bone and render surgical approach to the nerve much more simple.

If there is considerable destruction of nervous tissue, an early operation for complete repair of the nerve may indirectly cause distortion of the bone (Chap. xx). This applies particularly to cases in which the fracture invades the elbow joint. In these cases early passive motion is an important part of the treatment, and such motion is not possible if nerve suture is performed early. Also, in order to join nerve ends, the surgeon may be obliged to flex the elbow

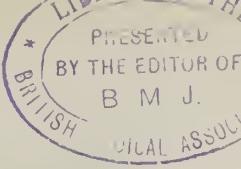


FIG. 63.

FIG. 64.

Figs. 63 and 64. Fracture of shaft of humerus treated with plaster cast and elbow splint.



FIG. 65.

FIG. 66.

Figs. 65 and 66. Method of applying plaster shell incorporating our elbow splints in fractures of humerus involving middle and lower third.



FIG. 67.

FIG. 68.

Figs. 67 and 68. End-results in same case as Figures 65 and 66, seven weeks after accident.



FIG. 69.



FIG. 70.

Figs. 69 and 70. Same case as Figures 65-67, thirteen weeks after accident.

FRACTURE RECORD									
Name	F.C.	Address	69th & GICHLU		White or Colored	Case No.	6875		
Age 24	Sex M F	M. S. #				Date	4-10-26 - 4:30 P.M.		
Occupation LABORER					Hospital Entered	ARCHER HOSPITAL			
Cause of Fracture PIECE OF ICE FELL ON HIS RIGHT ARM AND ELBOW									
First Treatment 4-8-26									
X-Ray No. 27410 Final Reduction									
EXAMINATION		TREATMENT				RESULT			
Bone	HUMERUS - RIGHT	Closed Reduction	X			Good	Moderate	Bad	
Site	JUNCTION MIDDLE AND LOWER THIRD	Method and Position of Fixation	SPECIAL SPLINT			X			
Type									
Scutule	X Transverse	Anesthetic Used	Yes						
Compound	Oblique	Anatomical Result obtained	GOOD						
Joint	Spiral								
Subluxated	Impacted								
Comminuted	Comminuted	Open Reduction							
Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve, etc.									
(a) At discharge from Hospital Date 4-16-26 GOOD ARM IN PLASTER CAST WITH SPECIAL ELBON SPLINT. GOOD ALIGNMENT AND POSITION OF FRAGMENTS. GOOD.									
(b) At discharge from O. F. D. Date 7-7-26 OBJECTIVELY NO ABNORMALITY. NO ATROPHY. FIVE DEGREES LIMITATION IN RANGE OF MOTION.									
Description of Deformity (including shortening)									
LOWER FRAGMENT DISPLACED MEDIAL AND UPWARD. SHORTENING SLIGHT.									
Anatomical Result obtained									
Nature and Extent of Injury to Soft Parts (mention scars and injuries)									
(a) At discharge date Date									
SEVERE CONTUSION AND SLIGHT PRESSURE Was non-operative treatment used first?									
LACERATION OF SOFT TISSUES RIGHT UPPER How long after injury was operation performed?									
Was internal fixation material subsequently removed?									
LAST TWO MONTHS FROM WORK.									
Mortality Date									
Main cause of death									
X-Ray COMPLETE TRANSVERSE FRACTURE 3 rd ABOVE JOINT. LOWER FRAGMENT INWARD.									
When									
Before Reduction GOOD									
Period of Complete Immobilization									
After Reduction GOOD CALLUS FORMATION									
Period of Protection									
Wassermann Test NEGATIVE Total Period of Protective Treatment									
*Present Wage earning capacity SAME									
Compensation obtained Yes? NO									
*Black Ink Surgeon's Opinion Red Ink Patient's Opinion									

Form 10 (A. S. S. Case Record System)
From January, 1926

FIG. 71. Fracture record of case shown in Figures 65-70.

at right angles or more. If some callus has been allowed to form about the site of fracture before joining the nerve ends, distortion of the bones will be minimized.

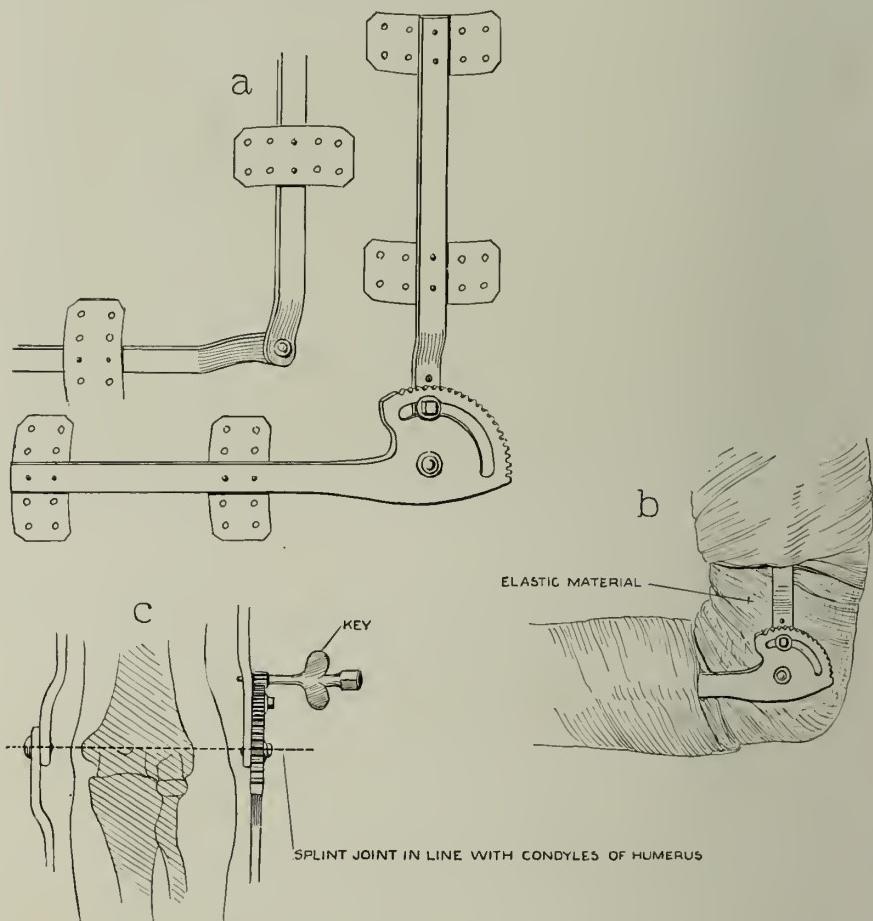


FIG. 72. Elbow splint which can be incorporated in plaster, as shown by preceding roentgenograms, for fractures of humerus involving shaft from middle of middle third down to and including elbow joint.

Further details will be found in Chapter xx.

PROGNOSIS. Disability lasts from four to six months. If there is involvement of the musculospiral nerve, the period of disability may be estimated at from one year to sixteen months in the event of

suture. Where suture is not required, but transplantation only, it will be shorter.

DISLOCATION OF THE HEAD OF THE HUMERUS

In dislocation of the head of the humerus there is very definite deformity about the shoulder. There is a depression below the acromion process of the scapula, with abduction of the arm and inability to flex the elbow or to carry the arm at the side with any degree of comfort. Loss of mobility is marked, and there is pain on any attempt at manipulation. Confirmation of the diagnosis by roentgenograms is very important as the film may show a complicating fracture. It is unnecessary to describe the different types of dislocation, as Cotton covers them in excellent detail.*

TREATMENT. Two methods of reduction are practically the only ones in use today. One is the familiar Kocher reduction method and the other is the old method whereby the operator places his foot, with the shoe removed, in the armpit of the patient and with hyperabduction and traction, followed by adduction, reduces. The Kocher method consists of four distinct steps, as shown in Figures 73 to 76.

The Kocher method can often be abbreviated. I have reduced a number of these dislocations in my office by administering $\frac{1}{4}$ grain of morphine (the morphine will help to produce muscular relaxation), waiting twenty to thirty minutes, then grasping the patient's upper arm with one hand, his forearm with the other hand, flexing the forearm on the upper arm with the upper arm against the side of the body, and very slowly and gradually rotating the upper arm outward as far as possible, even employing some force. This abbreviation, corresponding to the first and second motions of Kocher's method, is very simple and efficacious, but each motion must be made slowly so as not to increase muscle spasm. This can also be accomplished by direct injection into the capsule of a 2 per cent novocaine solution, as advocated by Prof. Lorenz Böhler of Vienna. I have used this method very successfully since visiting his clinic.

When the external rotation movement is complete, the arm should retain its position until any muscle spasm has ceased, and

* Cotton, F. J. Dislocations and Joint Fractures. Ed. 2. Saunders, Phila., 1924.

FIG. 73.



FIG. 74.



FIG. 75.



FIG. 76.

Figs. 73-76. Steps of Kocher's reduction of anterior dislocation of shoulder.

Fig. 73. Firm traction on lower end of humerus in position of abduction.

Fig. 74. External rotation of humerus with continued traction, using forearm as lever. This is a most important step and should be carried out *slowly* to extreme external rotation. Note that first two maneuvers should be done completely and slowly. Many who complain of little success with this method have been observed going through motions in rapid succession, overlooking fact that muscle spasm must be overcome. In first and second motions reduction can occasionally be improved by keeping upper arm closer to side of body.

Fig. 75. Lower end of humerus carried in adduction over chest, maintaining external rotation.

Fig. 76. Internal rotation of humerus, by forearm leverage in putting hand over opposite shoulder.

with the gradual relaxation of the muscles, the reduction will often be effected. If this does not accomplish reduction it may be necessary to give a general anesthetic and go through all four motions.



FIG. 77. Subglenoid dislocation of humerus. Note depression below acromion process with abduction of arm at elbow.

The third one is the carrying of the elbow across the chest with the forearm externally rotated; and the fourth, the internal rotation on laying the hand on the opposite shoulder.

After reduction the arm should be carried in a sling for two to three weeks. I urgently recommend at that period both passive and active massage.

COMPLICATIONS. Occasionally the *circumflex nerve* (p. 423) which supplies the deltoid, the teres minor muscles and the joint capsule, is injured, and this accident is followed by paralysis of the deltoid with loss of complete abduction. Unfortunately, compensatory muscle development does not always take place. An arthrodesis of the scapulohumeral joint may be necessary in order that the patient may use his arm at all. An arthrodesis consists of a removal of the cartilaginous head of the humerus, also the cartilaginous surface of the glenoid of the scapula in order to permit of a bony union of this articulation. In the event of performing the operation the postoperative position of the shoulder joint is extremely important. The arm *should not be placed outward from*

the side of the body, but forward in front of the body in order to obtain the best functional result.

Very often other muscles about the shoulder girdle not supplied



FIG. 78.



FIG. 79.

FIGS. 78 and 79. Subglenoid dislocation of humerus before and after reduction.

by the circumflex develop a compensatory action. Where the head has been out for a number of hours or a few days a complete brachial paralysis may occur. I have one such case under attention at present.

Sometimes the paralysis is followed by fibrosis. If the physician is convinced that the paralysis is incurable, he may leave the shoulder in a fibrosed state, since the fibrosis serves somewhat the same purpose as an arthrodesis and gives the patient the opportunity to develop compensatory shoulder movements. In cases in which the fibrosis interferes with the chances for lessening of the paralysis, the same treatment as that for fibrosis in the intracapsular type of traumatic arthritis (p. 45) is employed. Fracture of the greater tuberosity of the humerus is sometimes shown in the roentgenograms of a dislocated humerus. In such a case, after the dislocation has been reduced, the arm should be placed in a Littler-Jones splint, or in some other dressing that will produce a similar abduction of the arm. Fibrosis of the shoulder joint is likely to develop, and naturally the position of the arm induced by the Littler-Jones splint is the best one for practical use. Besides, it takes the pull off the plexus.

Fracture of the glenoid sometimes occurs as a complication of a dislocation. In these cases, also, the Littler-Jones splint should be applied for at least six weeks, so that, if fibrosis or ankylosis results, the patient may have the most practical use of his arm. If while the adduction splint is being worn the surgeon at the end of two to three weeks begins passive motion, *without removing* the splint, by raising the arm upward about every other day, the end-results will be even better.

Fracture of the surgical neck of the humerus as a complication of a dislocation is a very difficult condition to treat. I advise a radical open operation a few days after injury; i.e., in a week or ten days. The head of the humerus should be exposed, the dislocation and the fracture reduced by traction and manipulation, and after the tissues are closed, preferably a Littler-Jones splint applied. Occasionally after reduction some method of fixation of fracture is necessary. I find the intramedullary beef-bone peg most practical.

In some cases it is impossible to reduce the dislocation by means of an open operation, and removal of the head of the humerus becomes necessary. After the head is removed, all cartilage is removed from the surface, bone chips are interposed, the fractured end of the humerus brought into contact with the glenoid and an attempt made to procure a bony union of the scapulohumeral joint. The Littler-Jones splint, or one producing similar abduction, should be applied, so that, if ankylosis results, the patient will be able to abduct his arm partially above the shoulder.

In some cases of dislocation, *the brachial plexus* (see also p. 420) or one or more of its divisions, is involved. The Littler-Jones or a similar abduction splint should be applied for two and one-half to three months so that the nerves will not be subject to the strain of stretching. A slow sinusoidal galvanic current should then be applied in order to keep the muscles affected by the paralysis in a state of tonus until the regenerated nerves again take up their duties. If there is no sign of nerve regeneration at the end of six to nine months, either in the way of increased sensation or partial return of motor activity, *surgical intervention* should be considered.

PROGNOSIS. Uncomplicated cases of dislocation of the head of the humerus should be able to return to work within six to eight weeks. In case of involvement of the circumflex nerve, should the patient

recover function, the disability will extend from nine months to one year at least. In case of involvement of the brachial plexus, recovery, if it takes place, will sometimes take much longer. The complication of fracture also adds materially to the length of the disability period and prognosis should be guarded, depending upon the nature of the fracture. When fracture complicates this condition the disability should be doubled, as four to six months.

UNREDUCED DISLOCATION OF THE HEAD OF THE HUMERUS

Old unreduced dislocations of the head of the humerus are not uncommon and call for unusual surgical judgment. They should be treated only by a specialist. Open operation is the usual procedure, for only rarely is the closed method successful.

TREATMENT. In the open operation the best incision is that running from the acromion process of the scapula down over the anterior surface of the shoulder. The glenoid must be thoroughly cleaned out and the capsule and surrounding structures gradually stretched before reduction is attempted. Reduction is effected by rotation, abduction and adduction together with other motions which will be found necessary after exposing the condition. Very often on an old case of three to six months' standing it will be found impossible to reduce surgically. (See Figs. 50-53.)

When reduction is obtained, fix the head of the humerus in place by drilling a hole through the acromion process and head of the humerus, and use heavy kangaroo tendon to maintain the humerus in place. If this precaution is not taken, it may slip out of place even when all tissues are closed. Some surgeons use wire. When an ankylosis is anticipated it may be used.

After reduction, it is imperative that the arm be placed in the position of abduction obtained by use of the Littler-Jones or a similar splint, for if a postoperative ankylosis occurs, compensatory movements of a useful character can best be developed with the arm in abduction.

Postoperative treatment consists of the employment of all means known to physiotherapy and massage that may aid in muscle re-education. If massage and other special methods are not readily available, the patient may help himself by having constructed at home, in a doorway, the type of apparatus shown in Figure 36, in

which the counter-weight attachment assists in pulling the arm up and muscular force is exerted to pull the weight up. Passive and active treatment should start at about the third or fourth week.

COMMINUTED FRACTURE OF THE LOWER END OF THE HUMERUS INVOLVING THE ARTICULATION

These cases are usually the result of an injury severe enough to cause considerable fragmentation and displacement of bone with extension into the elbow joint.

SYMPOTMS. Diagnosis can be made from the evidence of deformity, marked swelling, muscular spasm, extreme pain and crepitation. Roentgenograms should be used to confirm the diagnosis and assist in reduction.

TREATMENT. There is much disagreement as to the best method of handling these cases.* My own opinion is that an immediate or early operation should be avoided, for callus is always rapidly formed in this part of the arm and when interfered with surgically it is markedly stimulated in growth. This rapid formation of callus, accompanied by immobilization of the elbow joint, results, as a rule, in almost complete ankylosis. It may be necessary, when the patient is first injured, to manipulate the elbow a little in order to lessen the pain and discomfort, but any attempts at complete reduction of the fracture should be avoided. Experienced surgeons may be able to show occasional good results from early complete reduction; certainly the average physician should avoid the procedure.†

The first step in the treatment of these fractures is the application of hot or cold dressings to reduce the swelling and bring the elbow down to as near its natural shape as possible. While this is being done, a simple posterior molded cast of plaster may be applied, outside the dressing, to avoid pain by keeping the fragments as quiet as possible.

In some cases where there is not much comminution the arm may be put in the Jones position of hyperflexion with supination. The

* Stewart, H. E. *Physiotherapy*. Ed. 2. Hoeber, N. Y., 1929.

Baetjer, F. H., and Waters, C. A. *Injuries and Diseases of the Bones and Joints*. Hoeber, N. Y., 1921.

† Occasionally I compound these cases surgically, but only when there is slight comminution of bone.

Jones position is full supination of the forearm followed by full flexion at the elbow. When this method is followed one should be *very careful* after reduction is made to see that there are *full pulsations*



FIG. 80.

FIG. 81.

Figs. 80 and 81. Badly comminuted elbow involving lower end of humerus and articulation.

of the radial and ulnar arteries. If these are not felt, extend the forearm until they are. Otherwise there will be in a few days a cold, numb hand and later a variable degree of gangrene ending with sloughing or a typical Volkmann's contracture or ultimate amputation. In the case of a well-muscled man, intense pain, due to interference with circulation, prevents the Jones position being attempted.



FIG. 82. Same case as Figures 80 and 81. Reduction of elbow with our splints applied.



FIGS. 83 and 84. Same case as Figures 80-82. Appearance of arm one month later.



FIG. 84.

However, the elbow may be flexed at right angles and gradually brought up every third or fourth day, thus avoiding muscle cramp. (See Böhler's method, p. 86.)



FIG. 85. Same case as Figures 80-84. Motion at end of six months. Still improving.

After ten days or two weeks the swelling should be sufficiently reduced to permit an open operation under general anesthesia when this is justified. No invariable technique can be given, because of variations in the nature and extent of the fracture in different cases. Good common sense, many kinds of manipulations, fluoroscopy and the intelligent study of roentgenograms are all important in the success of this operation. The best approach, in my estimation, is an inverted horse-shoe incision above the elbow, dissecting out and holding to one side the ulnar nerve; then the complete severing of the triceps tendon gives an entire exposure of the elbow.

After operation different methods may be used to hold the fracture in reduction, such as the application of an airplane splint, an ordinary molded plaster cast or a posterior molded cast. My own method is to avoid open operation as far as possible, but in either case, after swelling subsides, to apply a plaster cast which extends from the armpit down the elbow joint and continues about the elbow to the wrist, with the forearm in full or mid-supination, thus

FRACTURE RECORD

Name: G. L.		Address:	Case No. 74902
Age: 47	Sex: MALE	M. B. W.	Date 10-20-25 hr.
Occupation:		Dr. FORRESTER	
Cause of Fracture: FELL 6 STORIES			
		X-Ray No. 29604	Final Reduction
EXAMINATION		TREATMENT	
Bone: HUMERUS		Closed Reduction	
Site: LOWER 1/5 INTO JOINT		Method and Position of Fixation: MOBILE ELBOW	
Type:		SPLINTS APPLIED	
Simple	Transverse	Anesthetic Used	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Compound <input checked="" type="checkbox"/>	Oblique	Anatomical Result obtained: FAIR	
Int. Joint	Spiral	POSITION OF FRAGMENTS	
Subarticular	Impacted		
Gangrenous	Comminuted <input checked="" type="checkbox"/>	Open Reduction	NOSE
		Method and Position of Fixation	
Description of Deformity (including shortening)		(a) At discharge from Hospital: Date 11-15-25	
COMPOUND COMMINUTED FRACTURE OF HUMERUS INTO ELBOW JOINT		LBPF HOSPITAL ON OWN ACCORD. INFECTION HAD DEVELOPED	
Nature and Extent of Injury to Soft Parts (especially nerves and vessels)		(c) At subsequent date: Date	
BADLY LACERATED WOUND TO ELBOW		Was non-operative treatment tried first? Disability: Absent, Partial, Complete	
		New long after injury was operation performed?	
		Was internal fixation material subsequently removed?	
X-Ray		Why:	Mortality Date
Before Reduction	BADLY COMMINUTED	When:	Main cause of death
After Reduction	FAIR REDUCTION	Period of Complete Immobilization	Absence from work: Duration 5 MONTHS
At Discharge		Period of Protection	*Ability to resume job 3-15-27
Wassermann Test		Total Period of Protective Treatment	*Present Wage earning capacity
		Compensation obtained: Yes? <input checked="" type="checkbox"/> No? <input type="checkbox"/>	
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion			

Form 19(A.C. & Case Record System
Futura Company, Chicago)

F. H.

P. H.

P. J.

(Details of Treatment, Operation, X-Rays, Diagrams, etc.) CLOSED METHOD OF REDUCTION. AS INFECTION DEVELOPED FOLLOWING INJURY TO ELBOW JOINT. CASE WAS APPLIED IN WHICH OUR SPECIAL ELBOW "MOVABLE" SPLINTS WERE INCORPORATED AND MOTION STARTED AFTER 2 WEEKS. CAST LEFT ON 6 WEEKS AND THEN HEAT AND MASSAGE WERE GIVEN. PHOTOGRAPHS SHOW CAST AND AMOUNT OF MOTION. PATIENT IS WORKING. HAS 90° FLEXION AND 125° EXTENSION.

Form 19(A.C. & Case Record System
Futura Company, Chicago)

FIG. 86. Fracture record (front and reverse) of case shown in Figures 80-85.

relaxing the pronator radii teres muscle; when the first one or two layers of plaster have been applied, I incorporate a pair of splints which I have devised for these cases (Fig. 72).



FIG. 87.



FIG. 88.

Figs. 87 and 88. Simple T-fracture of lower humerus into elbow joint with comminution. Open operation March 9, 1927. Apposition of fragments by use of silver wire combined with cast and elbow splints. Roentgenogram taken June 13, 1927.



FIG. 89.



FIG. 90.

Figs. 89 and 90. Photograph of same case as Figures 87 and 88, showing range of motion at end of three months.

Böhler claims and demonstrates that the position of mid-supination to pronation with the elbow at right angles takes the pull off the internal condyle of the humerus, thereby preventing valgus deformity

and rotation of the internal condyle of the humerus and definitely preventing a Volkmann's contracture. I have found that he is correct.

When the cast has thoroughly dried and hardened, the plaster

FRACTURE RECORD					
Name	H.B.	Address	WAUKESHA, ILLINOIS		
Age	30	Sex	M	M F	M S W D --
Occupation	CONSTRUCTION WORKER				
Cause of Fracture					
	X-Ray No. 31563				
EXAMINATION		TREATMENT		RESULT	
Bone	HUMERUS, RIGHT	Closed Reduction		Anatomical	Good
Site	DISTAL END. T INTO JOINT.	Method and Position of Fracture		Functional	Moderate
Type					Bad
Skin	Transverse	Anesthetic Used	X Yes		
Concavous	Oblique	Anatomical Result obtained			
X Joint Joint	Spiral				(a) At discharge from Hospital Date
Subluxated	Increased				APPROXIMATELY FOUR WEEKS NO P.O.
Grooved	X Contracted	Open Reduction 3-9-27		INFECTION. SPECIAL ELBOW SPLINTS END	
Description of Deformity including shortening					
INCISION OVER DORSUM ELBOW, ULRN NERVE LAID ASIDE. REDUCTION, APPPOSITION AND WIRING. UNR NERVE RETURNED TO ITS BED.					
Anatomical Result obtained					
Description of Injury to Soft Parts					
(a) At admission date Date 11-29-27.					
Nature and Extent of Injury to Soft Parts					
Disability: Absent, Partial, Complete					
NONE					
Was non-operative treatment used first?					
How long after injury was operation performed?					
Was internal fixation material subsequently removed? NO					
X-Ray	Way	Mortality		Date	
Before Reduction SEPARATION OF FRAGMENTS		None	Main cause of death		
After Reduction		Period of Complete Immobilization	Absence from work: Duration TO 4-18-27		
At Discharge		Period of Protection	Ability to resume job: O.K.		
Wassermann Test NEGATIVE		Total Period of Protective Treatment	Present Wage earning capacity		
			Compensation obtained: Yes? No?		
			Black Ink: Surgeon's Order Red Ink: Patient's Order		

FIG. 91. Fracture record of case shown in Figures 87-90.

at the elbow joint is removed from the front and back of the cast, completely exposing the anterior and posterior portion of the elbow. The weight of this cast pushing on the forearm helps to maintain the fragments in good alignment and to reduce the number of adhesions by separating by traction the ulnohumeral joint. Such a cast and splints permit the instituting of early motion in the elbow joint, thus making possible (without the irritation produced by hand manipulation) a molding of the callus thrown into the articulation; that is, in conformity with the continuity of the joint surface.

Seventy-two hours after the application of the cast key motion is started in the elbow, extending over 5° or more, depending upon the severity of the injury. The elbow may be flexed during one treatment and placed in extension at the following treatment. At first motion should be permitted only every other day and then,



FIG. 92.

FIG. 93.

FIGS. 92 and 93. Roentgenograms taken January 26, 1927, showing healing of bone following surgical repair. Impossible to obtain roentgenograms prior to operation because of severity of injury and age of patient.



FIG. 94.

FIG. 95.

FIGS. 94 and 95. Roentgenogram of case shown in Figures 92 and 93, taken May 24, 1927



FIG. 96. Same case as Figures 92-95. End-result showing amount of motion in joint, spreading of fingers indicating regeneration of ulnar nerve. Photograph taken early in 1928.

FRACTURE RECORD					
Name <u>J.L.</u>	Address			Date <u>12-9-27</u>	Case No. <u>47804</u>
Age <u>24</u>	Sex <u>M</u>	Married <u>Single</u>	White <u>Black</u>	Hospital Entered <u>WEST SIDE HOSPITAL</u>	Dr. <u>FORRESTER & LILIAN</u>
Occupation				Time Occurrence of Accident <u>12-24-23</u>	
Cause of Fracture <u>FELL 8 FEET LANDING ON LEFT ELBOW</u>				First Treatment <u>12-24-23</u>	
				Final Reduction	
				X-Ray No. <u>26475</u>	
EXAMINATION		TREATMENT		RESULT	
Bone <u>HUMERUS</u>		Closed Reduction		Anatomical	Good
Site <u>ELBOW AND SHOULDER</u>		Method and Position of Fixation		Functional	Moderate
Type <u>DISLOCATION SHOULDER (SUB - GLENOID)</u>					Bad
Simple	Transverse	Anesthetic Used	Yes <u>X</u>		
Compound <u>X</u>	Obllique	Anatomical Result obtained			
Intra-artic. <u>X</u>	Spiral				
Subarticular	Tapered				
Greenstick	Comminuted <u>X</u>	Open Reduction	<u>12-24-23</u>		
Method and Position of Fixation <u>FIXATION BY WIRES</u>					
REDUCTION OF DISLOCATION AND ARM PLACED					
IN RIGHT ANGLE. ULNAR NERVE COMPLETELY					
SEVERED SO TRANSPLANTED TO FRONT OF					
ELBOW AND SUTURED.					
Anatomical Result obtained <u>FAIR</u>					
Description of Deformity including shortening					
<u>COMPOUND WOUND ABOUT ELBOW JOINT</u>					
<u>AND DEFORMITY FROM DISLOCATION OF</u>					
<u>SHOULDER</u>					
Description of Injury to Soft Parts especially nerves and vessels					
<u>OPEN TRAUMATIC WOUND AT ELBOW</u>					
Was non-operative treatment tried first? <u>NO</u>					
How long after injury was operation performed? <u>IMMEDIATELY</u>					
Was internal fixation material subsequently removed? <u>NO</u>					
(c) At subsequent due Date					
Disability: <u>Absent, Partial, Complete</u> <u>SEE PHOTO</u>					
SHOWING FLEXION AND MOTION IN FINGERS					
X-Ray					
Why <u>GAVE NO TROUBLE</u>					
When					
Before Reduction <u>MUCH DEFORMITY</u>					
After Reduction <u>FAIR APPROXIMATION</u>					
Period of Complete Immobilization <u>TWO WEEKS</u>					
Period of Protection <u>THREE TO FOUR MONTHS</u>					
Total Period of Protective Treatment					
Mortality					
Date					
Main cause of death					
Absence from work: Duration					
Ability to resume job					
*Present Wage earning capacity					
Compensation obtained: Yes? <u>No?</u>					
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion					

Form 19/A.C.B. Case Record System
Northern Cemetery, Chicago

FIG. 97. Fracture record of case shown in Figures 92-96.

as pain and spasm disappear, every day. It should be continued for at least eight to ten weeks, depending upon the rapidity of callus formation and the rate of bony union.



FIG. 98. Case treated by open operation on elbow.

After removal of the cast, at the end of two months or more during which time passive motion has been carried on, physiotherapy, including massage, is advisable. However, physiotherapy should be resorted to only when the surgeon is thoroughly satisfied that the healing process in the bone is complete, as such treatment, if

employed too soon and too violently, will increase the bony exudate and decrease the degree of motion finally obtainable.

Upon removal of the cast, should there be any question of a

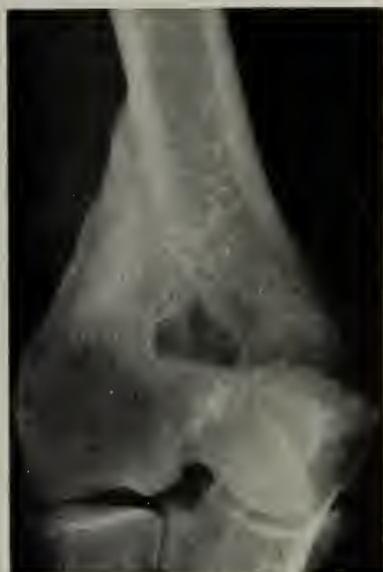


FIG. 99.



FIG. 100.

Figs. 99 and 100. Same case as Figure 98, condition six years later. Limitation of 25° in extension; no limitation in flexion.

complete ankylosis, since unquestionably there will be a specific loss of elbow motion, the most satisfactory position of the elbow is usually that of extension, 15° beyond a right angle. The vocation of the individual patient, however, must be taken into consideration, and the physician must use his judgment as to the best position for each patient.

Ulnar Nerve Involvement. In cases of both comminuted and non-comminuted fracture in which the ulnar nerve is involved, an open operation should be performed and the ulnar nerve transplanted to the front of the elbow (see Fig. 579). Such transplantation tends to avoid callus impingement upon the nerve, and also permits early passive motion in the elbow joint.

Bony Ankylosis. In those cases in which, in spite of all treatment, bony ankylosis develops, an arthroplasty should be considered. I

heartily recommend the procedures originated by W. Russell MacAusland of Boston, and Willis Campbell of Memphis, Tennessee.

PROGNOSIS. Unquestionably these cases will show a specific loss of motion in the elbow, which will vary in each patient. The physician must anticipate a period of total disability that will extend over four or six months, and a period of another two months of treatment before all possible function is restored to the joint. In cases in which roentgenograms show considerable comminution about the groove of the ulnar nerve, the physician should be guarded in his prognosis, since the possible encroachment of callus on the nerve may cause a mechanical pressure paralysis. In cases in which the ulnar nerve is definitely involved and is transplanted to the front of the elbow, the disability period may be lengthened by a year and a half to two years or longer, particularly where suture of the nerve is necessary.

In cases of possible bony ankylosis, treatment may cover a period of six to eight months before all possible function is restored to the arm.

UNCOMMUNITED FRACTURE OF LOWER END OF HUMERUS

This type of fracture has been very much discussed because treatment of it has generally been followed by a poor result.

SYMPTOMS. The roentgenogram serves to confirm the diagnosis which can be tentatively made from the symptoms of deformity, intense swelling, crepitation, preternatural mobility, pain and muscle spasm.

TREATMENT. As in cases of comminuted fracture, early open operation is contraindicated. For ten days to two weeks after injury, the arm, from the shoulder to the hand, should be supported at right angles by a simple posterior molded plaster shell. At the end of this time reduction under general anesthesia may be done. Reduction is best effected by beginning with straight extension and then, while continuing the extension, with as much strength as one can exert, gradually flexing the forearm on the arm as far as possible, again keeping in mind the importance of watching the pulsation of the radial and ulnar arteries.

After reduction is effected, an assistant applies traction on the forearm and the surgeon applies a complete cast from the shoulder

to the arm, with the forearm in mid-supination. After the first one or two layers of plaster have been applied, the pair of splints shown in Figure 72 is incorporated, the splints being applied with the forearm at right angles or more. (See Böhler's position, p. 86.)

After about twenty-four hours, when the cast is thoroughly dry and hard, a section of the cast about the front and back of the elbow is removed, thus permitting early passive motion (see Comminuted Fractures, p. 87, for details) that molds the forming callus to the contour of the elbow.

Such a cast, as previously explained, not only permits early passive movement, but by its sheer weight keeps the fractured bones in alignment and reduces the number of adhesions by separating by traction the ulnohumeral joint. The treatment causes very little pain to the patient.

This form of treatment does not insure to the patient full motion of the arm, but in my opinion it does guarantee greater functional activity than does any other method. The old method of applying a plaster cast which completely immobilizes the arm for six to eight weeks gives no opportunity for molding the forming callus as does the method of treatment which I have just described.

PROGNOSIS. Disability extends over a period of six to eight months, and a definite permanent loss of motion, varying in the individual case, must be expected. Ankylosis may result, necessitating the type of arthroplasty advocated by MacAusland or Campbell (p. 92), a complication which may extend the period of treatment to double that required in the average case.

CHAPTER VII

INJURIES OF THE ELBOW, THE RADIUS AND THE Ulna

DISLOCATIONS OF THE ELBOW

DISLOCATIONS of the elbow are usually posterior in type, although occasionally a lateral displacement is encountered.

SYMPTOMS. The posterior type of dislocation is characterized by a marked prominence of the olecranon, with pocketing over the triceps above. The condition is characterized by loss of mobility, marked pain and muscle spasm. The dislocation and the possible complications, such as fracture of the coronoid, the olecranon or the radial head, may be confirmed by the roentgen ray.

In the lateral type of dislocation, the displacement is almost always external to the condyle, and the elbow not only shows the prominence of the olecranon but a decided lateral irregularity, with the forearm displaced outward at the elbow to a marked degree. The elbow is flexed somewhat toward a right angle and as a rule the patient comes to the physician's attention holding the forearm with his other hand to prevent pain.

TREATMENT. In both the posterior and lateral forms the method of treating the dislocation is the same (Fig. 116). Occasionally, by first administering morphine to relax the muscles and novocaine locally, the reduction can be done in the surgeon's office. With an assistant exerting a very little traction upon the forearm, and slightly flexing and extending it, the operator places both thumbs against the point of the olecranon, closes his fingers about the cubital space in front and then pushes the olecranon forward with his thumbs. When the reduction is effected, a posterior plaster cast, extending from the middle of the upper arm to the mid-forearm at right angles, is applied and left on for two and one-half to three weeks. Motion is begun one week after the reduction of the dislocation.

PROGNOSIS. In uncomplicated cases disability lasts from six to eight weeks. It lasts longer if complications are present, such as fractures of the coronoid, fracture of the olecranon or, in cases of lateral displacement, involvement of the radial head or ulnar nerve (p. 437).

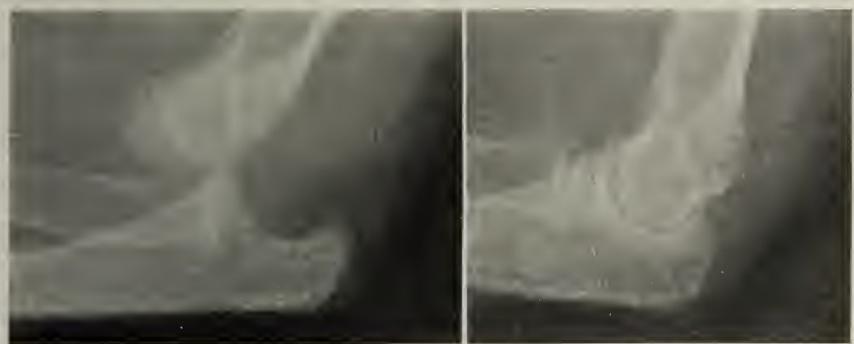


FIG. 101. Posterior dislocation of elbow without fracture.

FIG. 102. Same case as Figure 101, after reduction, still showing no evidence of fracture.

FIG. 103. Fracture record of case shown in Figures 101 and 102.



FIG. 104.



FIG. 105.

FIG. 104. Posterior dislocation of elbow with no apparent fracture.

FIG. 105. Same case as Figure 104. Roentgenogram after reduction shows slight fracture of coronoid process. Prognosis in such a type should be guarded because of possible further proliferation of bone resulting in limited motion, particularly in flexion.

FRACTURE RECORD					
Name J. M.	Address	Case No. 78803			
Age 32	Sex F.	M. S. W. D.	White or Colored	Date _____	
Occupation OFFICE WORKER				Hr. _____	
Cause of Fracture FALL BACKWARD FROM CURB IN PAVEMENT				Dr. _____	
X-Ray No.					
EXAMINATION		TREATMENT		RESULT	
Bone	RIGHT ELBOW	Closed Reduction	YES	Good	Moderate
Site		Method and Position of Fixation GENTLE TRACTION AND MANIPULATION. PLASTER SPLINT		Bad	
Type		Anesthetic Used	Yes	Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve	
Simple	Transverse			(a) At discharge from Hospital: Date	
Compound	Oblique	Anatomical Result obtained		DISAPPEARED	
Intra Joint	Spiral				
Subperiosteal	Impacted				
Grenwick	Comminuted	Open Reduction			
		Method and Position of Fixation			
Description of Deformity including shortening					
OBVIOUS DEFORMITY AND BACKWARD DISPLACEMENT OF ELBOW					
Anatomical Result obtained 4-14-27 SPLINT					
REMOVED. PHYSIOTHERAPY BEGUN WITH ACTIVE MOTION					
Was non-operative treatment tried first? (c) At discharge date: Date					
How long after injury was operation performed?					
Was internal fixation material subsequently removed?					
Why Mortality Date					
When Main cause of death					
Period of Complete Immobilization Absence from work: Duration					
Period of Protection *Ability to resume job					
Total Period of Protective Treatment *Present Wage earning capacity					
Compensation obtained: Yes? No?					
#Black Ink: Surgeon's Opinion #Red Ink: Patient's Opinion					

Form 194 (A.C.S. Case Report System)
Patients' Complaint—Osteoarthritis

FIG. 106. Fracture record of case shown in Figures 104 and 105.

DISLOCATION OF THE HEAD OF THE RADIUS

SYMPTOMS. This is an uncommon type of dislocation among workmen. When encountered, it is characterized by deformity, muscle spasm, pain on supination or pronation and change in position of the head on pronation. Lateral roentgenograms show clearly the change in position.

TREATMENT. Reduction is effected first by extension, then by gradual flexion, with a slight twisting motion of the forearm. After reduction the arm is kept in a flexed position for two or three weeks (Jones position). Gradual passive motion followed by active motion, when it can be tolerated, is then instituted. When placing in Jones position, watch the circulation carefully.

COMPLICATIONS. Injury to the musculospiral nerve may occur, necessitating repair (Chap. xx). Sometimes there is a chronic recurring dislocation, with loss of pronation and supination. In such a case an operation for the repair of the orbicular ligament or for the building of a new one is advisable. The building of a new orbicular ligament can be resorted to, using the fascia lata from the thigh. This takes considerable practice, however, hence I advise the average surgeon who does not do much of this work to suggest the removal of the head of the radius.

PROGNOSIS. In uncomplicated cases the disability extends over two or three months, and over an indefinite period (at least six to eight months) if the complications mentioned above occur.

FRACTURE OF THE HEAD OF THE RADIUS WITHOUT COMMINUTION

SYMPTOMS. These cases are characterized by pain on pressure over the head of the radius, by swelling and by muscle spasm which is notable on forced pronation, supination and flexion. Since this fracture is very often impacted, crepitation is not always present.

DIAGNOSIS BY ROENTGENOGRAMS. Great emphasis should be laid on the importance of verifying clinical findings by roentgenological findings. It is most important that the films show clear detail, as a fracture of the radius, particularly when impacted, is difficult to demonstrate. If necessary, numerous views should be taken.

TREATMENT. This form of fracture should *never* be treated by immobilization in a splint or cast. A well-defined bony ankylosis



FIG. 107.

FIG. 108.

FIGS. 107 and 108. Complete external lateral dislocation of the elbow without fracture, showing importance of two views.



FIG. 109.

FIG. 110.

FIGS. 109 and 110. Same case as Figures 107 and 108 after reduction.

FRACTURE RECORD

Name D.R.				Case No. 34792		
				Date Hr.		
Address						
Age 50	Sex M.	M. S. W. D.	White	Time Occurrence of Accident 2-6-22		
Occupation				Hospital Entered		
Cause of Fracture FELL, STRIKING ON RIGHT ARM				First Treatment		
X-Ray No. 13664				Final Reduction		
EXAMINATION		TREATMENT		RESULT		
Bone RIGHT ELBOW		Closed Reduction YES		Good	Moderate	Bad
Site		Method and Position of Fixation IMMobilized AFTER				
Type:		REDUCTION, POST PLASTER DULDED 2-15-22 REMOVED Yes FIXED DRESSINGS, CONSIDERABLE HARDNESS AND INDURA-				
Simple	Transverse	TION IN SOFT TISSUES ABOUT ELBOW				
Compressed	Oblique	REMAINED, TO BEGIN PHYSIOTHERAPY.				
Intra-Joint	Spiral	Open-Reduction 3-29-22-6 WEEKS.				
Subluxated	Emaciated	Brief Information on Treatment IMPROVING, LIVITA-				
Creamed	Comminuted	TION 10-15% NORMAL. INDURATION				
Description of Deformity (including shortening)						
COMMUNICATED FRACTURE LOWER END OF RADIUS INTO JOINT						
NATURE AND EXTENT OF INJURY TO SOFT PARTS (especially nerves and vessels)						
-14-22 - 3 MONTHS. WORK.				(c) At subsequent date Date		
Was non-operative treatment tried first?				Disability: Absent, Partial, Complete		
How long after injury was operation performed?						
Was internal fixation material subsequently removed?						
X-Ray COMPLETE LATERAL DISLOCATION				Mortality Date		
RIGHT ELBOW JOINT.				Main cause of death		
ARTHRITIS ROUGHENING ARTICULAR SURFACE				Absence from work: Duration		
Wassermann Test				Ability to resume job		
Total Period of Protective Treatment				Present Wage earning capacity		
				Compensation obtained: Yes? No?		
*Black Ink: Surgeon's Opinion Red Ink: Partner's Opinion						

Form 1975, C. S. Case Record System
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FIG. 111. Fracture record of case shown in Figures 107-110.

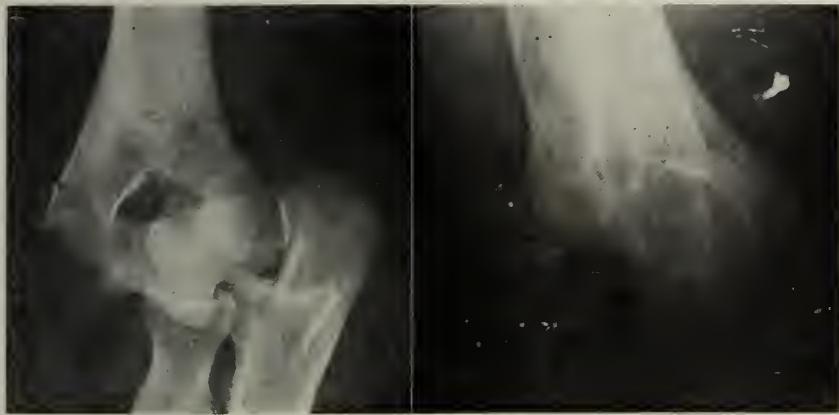


FIG. 112.

FIG. 113.

FIGS. 112 and 113. Dislocation of elbow with fracture of external condyle. Right elbow caught under beam during moving of house, causing complete internal dislocation of right elbow joint, with fracture of external condyle of humerus. Reduction of dislocation and fracture and arm put in position of acute flexion (Jones position). No lesion of peripheral nerves. Patient advised of danger of too long fixation; also advised to carry a counterweight from wrist to break down adhesions. Six weeks later, fairly good motion at elbow. Considerable thickening of callus around elbow.

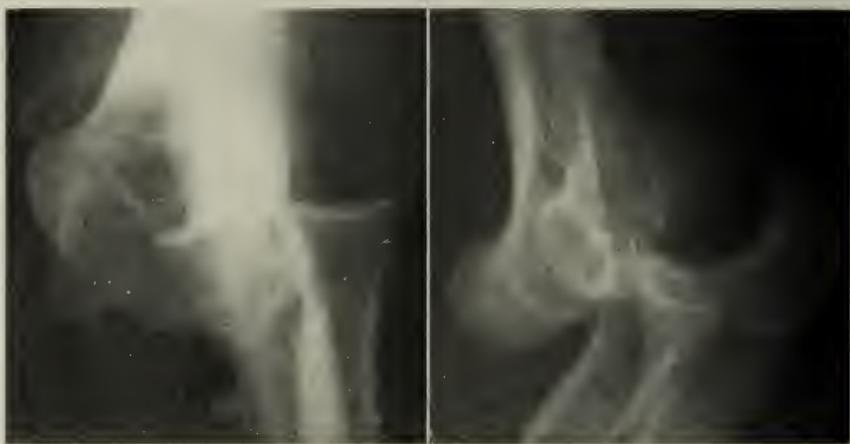


FIG. 114.

FIG. 115.

FIGS. 114 and 115. External dislocation of both bones of forearm with fracture.



FIG. 116. Technique of reduction of dislocated elbow.



FIG. 117.

FIG. 118.

FIGS. 117 and 118. Type of fracture of head of radius which does not necessitate surgical removal but calls for passive motion within first week and no fixation such as cast.



FIG. 119. Manipulation of fracture of head of radius, when not operated upon, to prevent bony ankylosis, motion and massage being started as early as the third or fifth day.

followed by a variable degree of limitation of motion is the result of two or three weeks of immobilization. No surgical intervention is necessary in this type of fracture.



FIG. 120. For use in home treatment of elbow fractures and fractures of radius at elbow to regain motion.

After the fracture has been recognized, the arm should be put in a sling, with the elbow at right angles or a little higher, and heat or cold should be applied for the first thirty-six to seventy-two hours. Mild passive massage of the extensor group of muscles over the head of the radius should then be begun. The method of performing such massage is shown in Figure 119. The operator stands behind the patient and while massaging the elbow joint with one hand, performs mild flexion and extension with the other, by grasping the patient's wrist or hand. At first this massage is done only every other

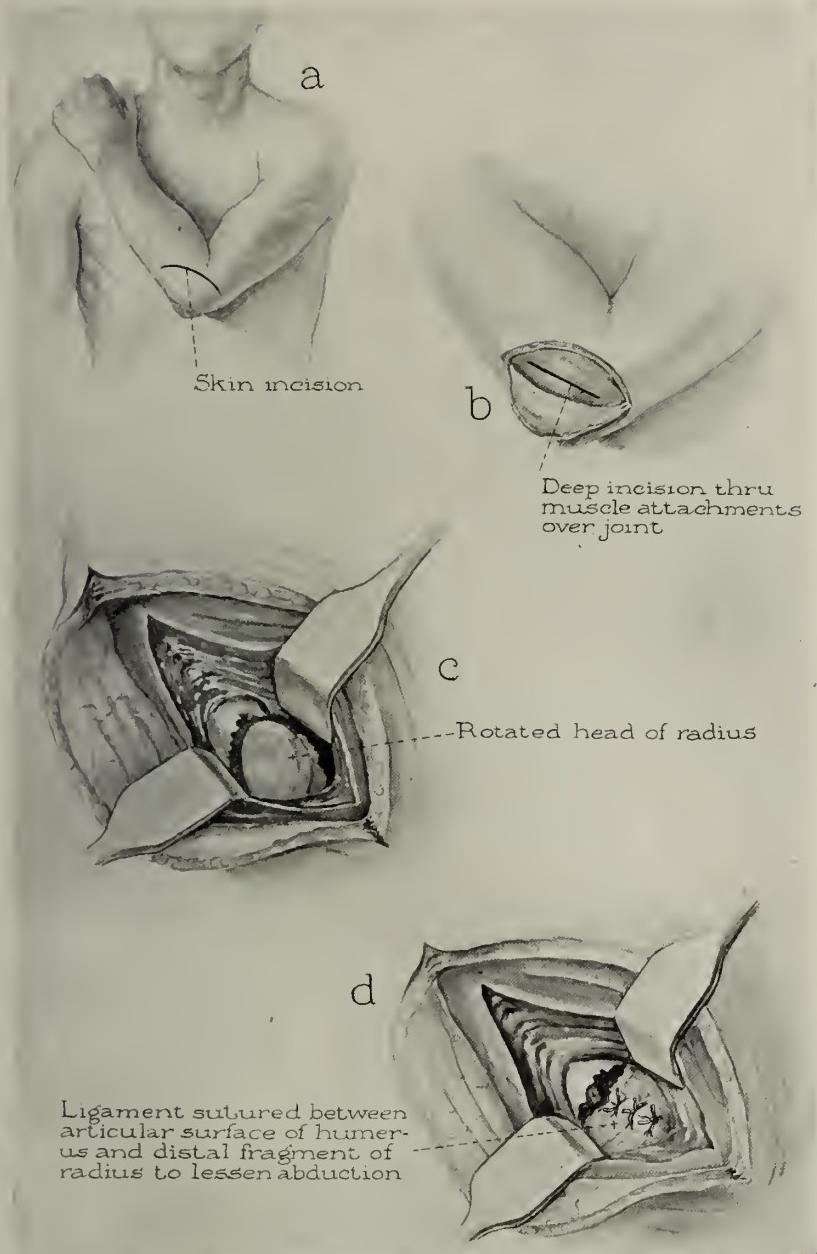


FIG. 121. Author's operation for removal of head of radius.

day, but when the pain decreases, it may be performed daily. Such treatment serves to mold the soft callus to the contour of the shaft and articular surface.

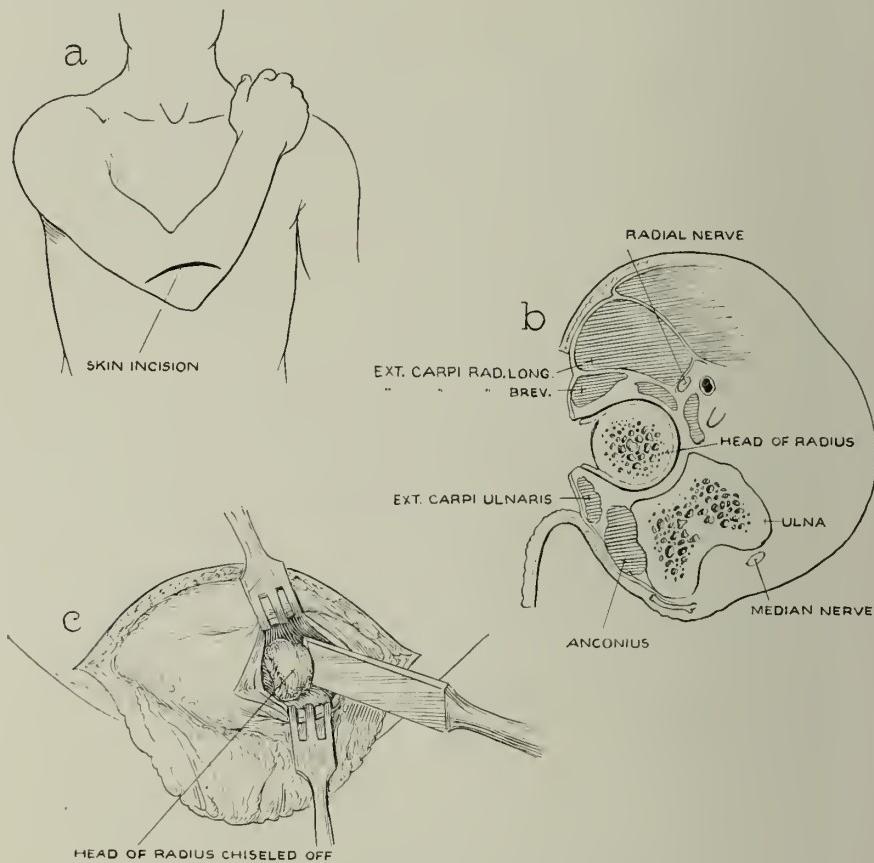


FIG. 122. Surgical anatomy of removal of head of radius.

Sling and Weight. The type of sling that allows the arm to be drawn up and let down a little every day, in the absence of the physician, should be supplied. Two or three weeks after injury, when the spasm has disappeared, the extension can be improved by simply tying a handkerchief around the wrist and suspending from it a 5 lb. weight which can be carried at the side (Fig. 120). The patient should not carry the weight in the hand because contractions of the

muscles do not then permit relaxation of the elbow. If, however, the weight is suspended from the wrist, the entire elbow joint is relaxed and stretched.

Treatment of Bony Ankylosis. If it is necessary to treat a case of bony ankylosis, the only thing one can do is resect the head of the radius (Figs. 121 and 122). When this has been done, the arm is placed in a sling, and slight motion started seventy-two hours later, as in the cases uncomplicated by ankylosis. Massage, however, should be delayed for about three weeks, in order that the tissues may have an opportunity to heal.

PROGNOSIS. If these cases are treated by early mobilization, the period of total disability extends over two to three months, and the period of partial disability covers another month.

FRACTURE OF THE HEAD OF THE RADIUS WITH COMMINUTION

SYMPTOMS. These are the same as in the previous type, only more exaggerated.

TREATMENT. In these cases the question of surgical interference is a difficult one. If the comminution is slight and there is no displacement of fragments outside the orbicular ligament, early manipulation alone should be tried as in the impacted form without comminution. But when the comminution is severe, even though there may be no displacement of fragments outside the orbicular ligament, surgical removal of the fragments is usually advisable. In cases showing definite evidence of displacement of fragments outside the ligament, surgical removal of the fragments is unavoidable.

Operation should be performed a week or ten days after injury. Passive motion should be begun seventy-two hours after operation and continued until recovery.

Occasionally there develops, particularly following surgical removal of the head of the radius, an angulation at the elbow upon extension which causes an adduction of the forearm of from 10° to 20° . This angulation in no way affects the function of the arm.

PROGNOSIS. The period of disability in these cases of surgical interference is approximately the same as in those treated only by



FIG. 123.



FIG. 124.

FIGS. 123 and 124. Extensive comminution with dislocation of fractured head of radius, found upon operation on inner side of elbow. All fragmentation was removed, and surgical repair followed.



FIG. 125.



FIG. 126.

FIGS. 125 and 126. Same case as Figures 123 and 124, seven and one-half months later.



FIG. 127.



FIG. 128.



FIG. 129.

FIGS. 127-129. Photographs showing end-result following removal of head of radius. Mark shows location of incision. Amount of flexion as compared with other arm, and also extension shown. Note slight abduction at elbow.



FIG. 130.



FIG. 131.

FIGS. 130 and 131. Postoperative roentgenogram of resection of head of radius showing rounding-off of bone without excess bone formation.



FIG. 132.



FIG. 133.

FIGS. 132 and 133. Fracture dislocation of elbow with comminuted fracture at head of radius. Head of radius was resected about twelve days after injury.

FIG. 134.



FIG. 135.



FIG. 136.



FIG. 137.

FIGS. 134-137. Same case as Figures 132 and 133. The final plate (lower right) shows an excessive amount of bone regeneration at head of radius which resulted in marked limitation in motion. We point this out as type of bad result which might be due either to excessive fragmentation of bone distributed in surrounding soft parts, or to technical failure to remove completely fragments and attached periosteum.

early mobilization (four months). Occasionally in older people or those with a tendency to fibrosis, the disability may run six months.

OLECRANON BURSITIS

Olecranon bursitis is a common result of trauma and is characterized by a marked effusion of the bursa which lies on the external surface of the elbow at the point of the olecranon process.

SYMPTOMS. In addition to effusion within the bursal sac, the symptoms are those of fluctuation, redness, tenderness and pain. If the condition has become chronic, there are thickened cartilaginous deposits similar to those found in the knee joint.

TREATMENT. If the patient is seen early, strapping of the elbow joint with adhesive half-way around the elbow frequently effects a slow cure. In the cases with a decided tendency toward chronicity, and most cases show this tendency, a thorough injection of 2 per cent novocaine, all through the tissues, with removal of the bursal sac, is by far the most satisfactory form of treatment. The anatomical formation of the sac is such that, upon removing the sac, the tendon of the triceps muscle, which attaches to the olecranon, must be exposed; but this exposure is not dangerous if asepsis is perfect, and after closure the skin layers are sufficient to protect the fascia. Following the removal of the sac, some antiseptic such as mercurochrome should be used, and complete closure can then be made without danger. The joint should be immobilized for a week or ten days before motion is instituted.

Aspiration of the sac is unsatisfactory, for not only does the fluid usually reform, but the procedure encourages infection. Once infection takes place, a chronic sinus develops which necessitates surgical treatment.

PROGNOSIS. In cases treated by removal of the bursal sac, the period of disability extends over two or three weeks and is followed by no specific loss of function.

FRACTURE OF THE OLECRANON

SYMPTOMS. This injury is easily diagnosed by the amount of effusion about the elbow. Usually the patient gives a history of a

FIG. 138.



FIG. 139.



FIG. 140.

FIGS. 138-141. Fracture of olecranon. (See chart, Fig. 142.)



FIG. 141.

FRACTURE RECORD							
Name: MISS C.	Address:	Case No.: 33763		Date: _____	Dr. _____		
Age: 21	Sex: F.	M. S. I. C. D.: 33	White or Colored:	Time of Occurrence of Accident: 11-28-21			
Occupation:				Hospital Entered:			
Cause of Fracture: CAUGHT HEEL IN DOORWAY AND FELL				First Treatment:			
				Final Reduction:			
EXAMINATION		TREATMENT		RESULT			
Bone: LEFT ELBOW		Closed Reduction		Anatomical	Good	Moderate	Bad
Site:		Method and Position of Fracture:		Functional			
Type:		Anesthetic Used: Yes No		Description of End Result, including Disability, Shortening, Function, Tissue, Swelling, Nerves			
Simple	Transverse			70° AT discharge from O.P.D. Date: 10-20-22			
Compound	Osteo			LIMITATION 30° EXTENSION, 50° FLEX.			
(Int. Joint)	Spiral			1-24-25 WIRE REMOVED FROM ELBOW.			
Subperiosteal	Impacted			DEVELOPED FIBROSIS WITHOUT ANY INFECTION, THIN TYPE.			
Greenstick	Comminuted	Open Reduction		(b) At discharge from O.P.D.: Date			
Method and Position of Fracture: 12-11-21				OPERATION: OLECRANON WIRED THRU			
Description of Deformity including shortening:				OUTER SHELL TO PARENT BONE, GOOD.			
FRACTURE OLECRANON PROCESS INTO JOINT, FRAGMENTS DISPLACED.				APPOSITION. 1-17-22 HEALING BY			
FIRST INTENTION.				EARLY MOTION STARTED, NOW GETS 40°			
Nature and Extent of Injury to Soft Parts especially nerves and vessels				AT ELBOW, COOPERATES POORLY IN MOTION. 1-17-22 X-RAYS SHOW GOOD POSITION, BONY UNION OF FRAGMENTS. 25% NORMAL ELBOW MOTION BECAUSE OF			
				(c) At admission date: Date Disability: Absent, Partial, Complete			
X-Ray:	W/F POOR COOPERATION.			Mortality	Date		
Before Reduction			When:	Main cause of death:			
After Reduction			Period of Complete Immobilization:	Absence from work: Duration			
At Discharge			Period of Protection:	Ability to resume job:			
Wassermann Test:			Total Period of Protective Treatment:	*Present Wage earning capacity:			
				Compensation obtained: Yes? No?			
				Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion			

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FIG. 142. Fracture record of case shown in Figures 138-141.

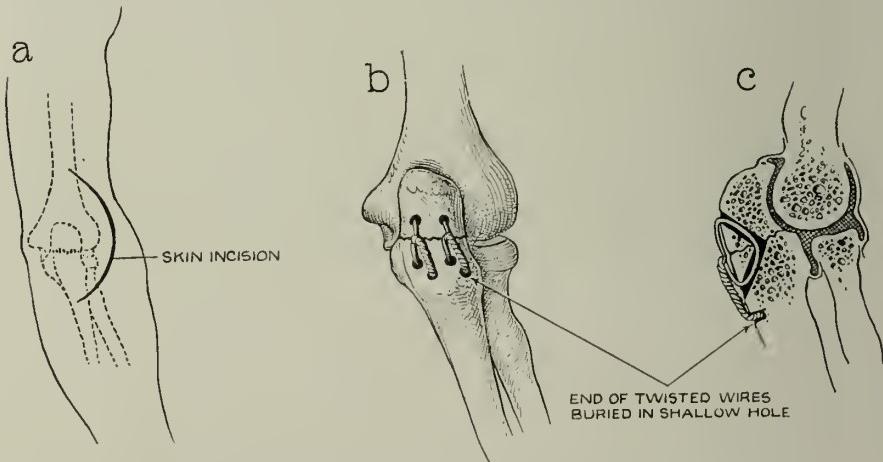


FIG. 143. Author's method of wiring olecranon in simple transverse fracture.

fall upon the elbow, or some other form of direct injury to the elbow. Muscle spasm is present and also definite crepitation upon manipulation of the broken fragments. Occasionally where fracture is severe with marked separation of fragments there is inability to extend the forearm on the arm.

When the roentgenogram is used to confirm the diagnosis, the lateral view is preferable, although an anteroposterior view is advisable, in order to make sure there is no extension involvement of the articulation.

TREATMENT. *Fracture of the Olecranon with Separation.* An open operation is the preferred method of treatment and but for the exceptional case discussed on page 115, should be the only method used in any olecranon fracture. This injury, as a rule, takes place through the neck of the olecranon process with separation and tearing of the aponeurosis of the triceps. Since the olecranon is in direct contact with the articulation of the lower end of the humerus, and, in the states of flexion and extension, comes into contact with the contour of the humeral articulation, olecranon fracture with separation and tearing of the triceps is liable to cause functional limitation. Surgical immobilization, then, is necessary to permit early passive motion.

I prefer to wire the olecranon, as shown in Figure 143. A solid bony approximation should be achieved without invasion of the joint by any foreign substance. Passive motion can be instituted after seventy-two hours, provided no infection is present. Passive motion probably must be continued for a period of six to eight weeks, and must then be followed by active motion and massage.

Fibrosis. A septic fibrosis may arise from improper surgical technique. A fibrosis not due to the surgical technique may occur in an undernourished person and may be due to focal conditions, improper nutrition or, because of fear of mobilization, insufficient movement of the elbow. In spite of treatment, there is always some limitation of motion, but sometimes after a year or a year and a half of use, motion which approaches normal may be attained. At the end of four to six months of treatment, these patients, particularly those showing a tendency to a fibrosis, should be induced to work in order that the added exertion may aid in the effort to attain the best possible functional result. Occasionally such cases



FIG. 144.



FIG. 145.

FIGS. 144 and 145. Comminuted fracture of olecranon showing multiple wiring of fragments.



FIG. 146.



FIG. 147.

FIGS. 146 and 147. End-result of case shown in Figures 144 and 145, demonstrating amount of motion.

can be wrenched under anesthesia. One must be careful to choose his cases and continue massage and motion often.

Fracture of the Olecranon without Separation. In exceptional



FIG. 148.



FIG. 149.

FIGS. 148 and 149. Simple fracture of olecranon without separation of triceps aponeurosis. Open operation unnecessary. Elbow splints used.



FIG. 150.



FIG. 151.

FIGS. 150 and 151. End-results in case shown in Figures 148 and 149.

cases, fracture of the olecranon occurs without separation, indicating that the aponeurosis of the triceps is not torn. Surgical procedure may then be dispensed with, and instead, a posterior molded plaster cast, reaching from the axilla to the hand, immediately applied in the position of a right angle. The cast must be worn for two and a



FIG. 152.



FIG. 153.

FIGS. 152 and 153. Fracture of olecranon with very little separation, treated with our elbow splints. For end-results see chart (Fig. 157).



FIG. 154. Same case as Figures 152 and 153.

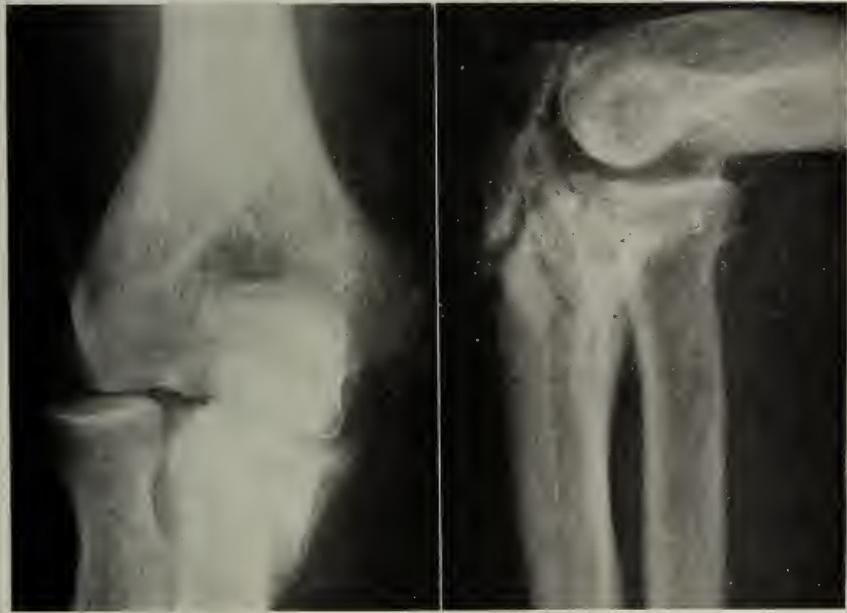


FIG. 155.

FIGS. 155 and 156. Same case as Figures 152-154.

FIG. 156.

IMPERATIVE TRAUMATIC SURGERY

half to three weeks; but beginning three or four days after its application, it may be removed for a short time every other day and passive motion and massage practiced. When the cast is permanently

FRACTURE RECORD					
Name	J. S.	Address	921 N. TRIMBELL	Time: Occurrence of Accident	
Age	54	Sex	M. F.	White or Colored	
Occupation	ELECTRICIAN			Hospital Entered	WEST SIDE
Cause of Fracture	FELL ABOUT 20 FEET LANDING ON BACK AND RIGHT ELBOW			First Treatment	11-8-26
			X-Ray No. 29725	Final Reduction	11-17-26
EXAMINATION		TREATMENT		RESULT	
Bone	RIGHT ULNA	Closed Reduction	YES	Good	Moderate
Site	OLECRANON PROCESS	Method and Position of Fixation	HINGED CAST	Functional	Bad
Type:					
Spiral	Transverse	Anesthetic Used	Yes	Description of End Result Including Deformity, Shortening, Function, Pain, Swelling, Nerve	
Compound	Obligate	Anatomical Result obtained	GOOD	(a) At discharge from Hospital	Date 11-19-26
Intra Joint	Spiral	LOSS 15 DEGREES FLEXION		NO SHORTENING. NO DEFORMITY EXCEPT	
Subarticular	Impacted	LOSS 10 DEGREES EXTENSION		THICKENING ABOUT OLECRANON. NO PAIN,	
Greenslade	Comminuted	Open Reduction		NO NERVE INVOLVEMENT. LOSS 15 DEGREES	
		Method and Position of Fixation		FLEXION AND 10 DEGREES EXTENSION	
Description of Deformity (including shortening)	THICKENING			(b) At discharge from O. P. D.: Date	
ABOUT ELBOW JOINT					
Nature and Extent of Injury to Soft Parts Especially nerves and vessels		Anatomical Result obtained			
				(c) At subsequent date: Date	
				Disability: Absent, Partial, Complete	
<input checked="" type="checkbox"/> FRACTURE OF OLECRANON AT JOINT.		Was non-operative treatment tried first?	YES		
<input checked="" type="checkbox"/> POSTERIOR DISPLACEMENT MAJOR		How long after injury was operation performed?			
X-Ray		Was internal fixation material subsequently removed?			
Before Reduction	FRAGMENT.	Why		Mortality	Date
After Reduction	GOOD POSITION	When		Main cause of death	
At Discharge	GOOD POSITION. CALLUS FORMATION	Period of Complete Immobilization	21 DAYS	Absence from work: Duration	62 DAYS
Wassermann Test		Period of Protection	20 DAYS	*Ability to resume job	YES
		Total Period of Protective Treatment	30 DAYS	*Present Wage earning capacity	SAME
				Compensation obtained: Yes? <input checked="" type="checkbox"/>	
<small>*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion</small>					

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FIG. 157. Fracture record of case shown in Figures 152-156.

removed, the arm can be carried in a sling, the passive motion and massage continuing for another three weeks before active motion is begun.

Occasionally, when the fracture is more extensive, but without separation of the triceps aponeurosis, a plaster cast from the shoulder to the fingers, with the elbow splints incorporated, can be used to great advantage (Figs. 152 to 157).

PROGNOSIS. The period of total disability lasts ten or twelve weeks, and the following period of partial disability extends over a month or six weeks. In the cases of fibrosis, a year or a year and a half of treatment may be necessary before a functional result approaching the normal is attained.

FRACTURE OF THE CORONOID OF THE ULNA

This is a rare fracture, usually the result of a crushing injury which also produces posterior dislocation of the elbow joint. The

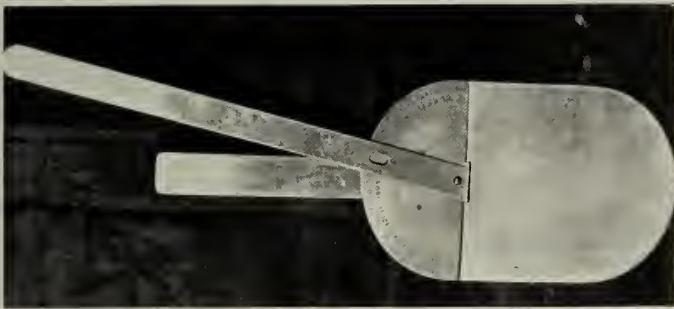


FIG. 158.



FIG. 159.

FIGS. 158 and 159. A simple form of arthrometer made of sheet aluminum for accurate determination of joint motion.

symptoms include pain in the coronoid fossa, muscle spasm and limitation of motion during both flexion and extension. Crepitus can be developed only with difficulty. The roentgen ray, particu-

larly the lateral view, readily confirms the diagnosis (Figs. 101 and 102).

TREATMENT. After reduction, which is produced by full ex-



FIG. 160.



FIG. 161.



FIG. 162.

FIGS. 160 and 161. Irreducible fracture of both bones of forearm.

FIG. 162. Same case as Figures 160 and 161, operated upon one month later, using intramedullary beef-bone peg.

tension followed by flexion, the arm should be placed in flexion in the Jones position, with the forearm fully supinated. At first, in a patient with a muscular, inflamed arm, interference with circulation will make this position a painful one. Gradually, however, the arm can be got into the desired position, which should be maintained for three weeks. Slow passive motion with extension may then be begun, the arm being brought down a little each day until full extension is obtained.

If the fracture is compounded, the median and musculospiral nerves should be examined with great care, and, if injured, immediate surgical treatment instituted (p. 426).



FIG. 163.

FIG. 164.

Figs. 163 and 164. Same case as Figures 160-162. Roentgenogram taken seven weeks later, showing gradual absorption of peg, also union with good position.

PROGNOSIS. Total disability lasts from two to three months. Some limitation of motion may persist in regard to complete flexion or extension. Nerve involvement entails a guarded and more extended prognosis.

FRACTURE OF THE BONES OF THE FOREARM INVOLVING THE UPPER TWO-THIRDS

Fractures of this type, involving one or both bones, are characterized by swelling, muscular spasm, pain, preternatural mobility, crepitation and sometimes distortion. The diagnosis should, of course, be confirmed by the roentgenogram.

IMPERATIVE TRAUMATIC SURGERY

TREATMENT. Fractures involving the upper two-thirds of the bones of the forearm rarely, if ever, need be treated by surgical interference because the muscle bellies surrounding the bones assist

FRACTURE RECORD				Case No. 74833 Date 10-14-26, 4:45 P.M. Dr.									
Name J.M.	Address	Age 26 Sex M	W. S. 26-28	White or Colored									
Occupation CHAUFFEUR				Time of Occurrence of Accident 10-14-26									
Cause of Fracture WAGON HIT OUTSTRETCHED LEFT ARM				Hospital Entered WEST SIDE HOSPITAL									
				First Treatment									
				Final Reduction									
EXAMINATION		TREATMENT		RESULT									
Bone LEFT RADIUS AND Ulna UPPER THIRD LEFT		Closed Reduction		<table border="1"> <tr> <td>Good</td> <td>Moderate</td> <td>Bad</td> </tr> <tr> <td>X</td> <td></td> <td></td> </tr> <tr> <td>X</td> <td></td> <td></td> </tr> </table>	Good	Moderate	Bad	X			X		
Good	Moderate	Bad											
X													
X													
Site RADIUS LOWER THIRD LEFT ULNA		Method and Position of Fixation		Description of End Result, including Disability, Swelling, Function, Pain, Swelling, Nerve									
Type				(a) At discharge from Hospital Date 11-25-26									
Similar X	Transverse X	Anesthetic Used	Yes	CAST STILL ON AND SUTURES INTACT.									
Compound	Obligate X			WINDOWS WILL BE CUT IN CAST LATER AND									
Intra-Join	Spiral			SUTURES REMOVED. 11-29-26 STITCHES AND									
Subperiosteal	Impacted			CAST REMOVED AND POSTERIOR MOLDED SPLINT									
Crossnick	Comminuted	Open Reduction	10-29-26	APPLIED. 1-5-27 CAST REMOVED. 4-22-27									
		Method and Position of Fixation		At discharge from O.P.D. Date									
Description of Deformity (including shortening)		INTERMEDULLARY ROD		LIMITATION OF EXTERNAL ROTATION. SOME									
		BONE PEG IN RADIUS. Ulna HELD BY KANGAROO		RESTRICTED MOTION OF WRIST JOINT.									
		TENDON. TISSUES CLOSED AND PLASTER CAST											
		APPLIED. END TO END APPROXIMATION OF											
		BOTH BONES.											
		Anatomical Result obtained GOOD											
Nature and Extent of Injury to Soft Parts (especially nerves and vessels)													
				(c) At subsequent date Date									
		Was non-operative treatment tried first?		Disability: Absent, Partial, Complete									
		How long after injury was operation performed? 15 DAYS											
		Was internal fixation material subsequently removed? NO											
X-Ray		Why		Mortality Date									
Before Reduction 3/4" OVERLAPPING OF BOTH BONES		When		Main cause of death									
After Reduction 11-1-26 GOOD ALIGNMENT		Period of Complete Immobilization 2 1/2 MONTHS		Absence from work: Duration 4 MONTHS									
At Discharge ALIGNMENT GOOD		Period of Protection 2 1/2 MONTHS		*Ability to resume job									
Wassermann Test NEGATIVE		Total Period of Protective Treatment		*Present Wage earning capacity									
		HEAT AND MASSAGE BEGUN 2 1/2 MONTHS		Compensation obtained: Yes? No?									
		AFTER REDUCTION		*Black Ink: Surgeon's Signature Red Ink: Patient's Signature									

Form 19 A.C.S. Case Record System
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FIG. 165. Fracture record of case shown in Figures 160-164.

materially in maintaining a fair alignment, and, with manipulation, a satisfactory functional reduction can always be made. The reduction need not be perfect anatomically since perfect anatomical alignment is not necessary for perfect function. This fact, as mentioned in Chapter II, should be explained to the patient.

After reduction, the arm is placed in mid-supination or full supination, depending upon which position permits the best alignment.

A plaster cast can be applied in the position of preference and allowed to remain on for six to eight weeks. When one bone only is fractured, little if any displacement usually exists.

Occasionally there occurs a fracture in the upper third of one bone and the lower third of the other, in which event it may not be

easy to hold the fragments, particularly if they are oblique, etc. Surgery is then necessary, as shown in Figures 160 to 165.

Limitation of Motion. Occasionally when one bone of the forearm, particularly the ulna, is fractured, and the arm is fixed in flexion at right angles by means of a posterior molded plaster cast, and *Maintained too long* in that position, a firm union results. This union causes limitation of motion in the elbow joint during flexion and extension, due to shortening of the long axis of the ulna, causing the head of the radius to impinge against the external condyle.

I have in mind the case of a man whose ulna was fractured in two places: at approximately the middle upper third and at the middle lower third. One of these fractures was treated by the closed method and the other surgically corrected with wiring, and the arm was immobilized at right angles. After prolonged immobilization, almost complete ankylosis of the elbow joint developed.

Three unsuccessful operations were performed about the elbow joint before the patient was brought to me. My roentgenograms showed no involvement of the radius either at articulation or through the shaft. I concluded that a mechanical locking of the elbow joint had taken place, through shortening of the long axis of the ulna, forcing the head of the radius against the humeral condyle. I advised resection and removal of the head of the radius. This operation was performed and was followed by complete recovery of function.

Occasionally in fractures of both bones where they are oblique and a good alignment cannot be obtained, an intramedullary beef-bone peg can be used to considerable advantage (Fig. 162). Excellent beef-bone pegs for this work are now being manufactured, put up in sealed glass containers. Free beef-bone pegs that can be boiled as are instruments, may also be procured.

PROGNOSIS. The disability in fractures of this kind lasts for a period of four to six months.

FRACTURES OF THE BONES OF THE FOREARM INVOLVING THE MIDDLE AND LOWER THIRD

These fractures vary greatly, being sometimes longitudinal, sometimes transverse, sometimes oblique and comminuted, as well as compounded.



FIG. 166.



FIG. 167.

FIGS. 166 and 167. Case that can be corrected by simple procedure of opening locking serrated edges, thereby avoiding use of any foreign material. Incision for reduction made over the radius only.



FIG. 168.



FIG. 169.

FIGS. 168 and 169. Same case as Figures 166 and 167, four months later, showing union.

SYMPTOMS. Such fractures are always demonstrated by unusual mobility (much more so than is the case in one-bone fractures), and by pain and swelling over both bones with deformity and

FRACTURE RECORD					
Name C. W.	Address	Case No. 34620 Date 1-15-22 Dr. F. C. REEDER			
Age 41 Sex M	M. S-W-P	White or Colored	Time of Occurrence of Accident 1-23-22		
Occupation CONCRETE WORKER			Hospital Entered WEST SIDE HOSPITAL		
Cause of Fracture MAN'S SLEEVE WAS CAUGHT IN A BELT LACING WHILE APPLYING DRESSING			First Treatment 1-23-22		
		X-Ray No. 13347	Final Reduction 2-3-22		
EXAMINATION		TREATMENT		RESULT	
Bone RADIUS AND Ulna	Site MIDDLE THIRD FOREARM	Closed Reduction NOT SUCCESSFUL	Method and Position of Fracture	Good	Moderate
			Anesthetic Used Yes 340		Bad
			Anatomical Result obtained NOT SATISFACTORY	X	
				X	
Open Reduction					
		Description of End Result, including Deformity, Shortened, Function, Pain, Swelling, Nerve			
		(a) At discharge from Hospital Date ARM IN CAST			
		(b) At discharge from O. P. D. Date INFECTED DEVELOPED			
Description of Deformity including shortening					
COMMINUTED FRACTURE MARKED DISPLACEMENT AND DESTRUCTION OF INTEROSSEOUS SPACE.					
		(c) At rehabs date Due 15% FUNCTIONAL LOSS			
Nature and Extent of Injury to Soft Parts					
CONTUSION AND BRUISES ABOUT FOREARM.					
		(d) At rehabs date Disability Absent, Partial, Complete			
X-Ray					
Before Reduction MUCH DISPLACEMENT					
After Reduction GOOD REDUCTION					
At Discharge COMPLETE CALLUS					
Wassermann Test NEGATIVE					
		Who		Mortality	
		Period of Convalescent Immobilization 5 WEEKS		Date	
		Period of Protection 7 WEEKS		Main cause of death	
		Total Period of Protective Treatment		Absence from work Duration 3 MONTHS	
				*Ability to resume job	
				*Present Wage earning capacity	
				Compensation obtained Yes No	
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 15-A.C.S. Case Record System
Futura Company, Chicago

FIG. 170. Fracture record of case shown in Figures 166-169.
crepitation. The roentgen rays confirm this.

TREATMENT. *Fracture of One Bone.* If but one bone is fractured, it can be reduced by the closed method and the arm held in full supination by a full molded plaster cast. Occasionally the arm may be placed in mid-supination. This fracture must be studied on account of the question of muscle balance.

Transverse Fracture of Both Bones. If there is transverse fracture of both bones of the forearm, I first attempt closed reduction. If this is unsuccessful, I leave the arm alone for ten days to two weeks, during which period both extensors and flexors contract to a slight degree, causing a shortening of one-half to one inch. A small incision is then made over both bones, the serrated edges of bone exposed, and, by means of manipulation and traction, reduction and approximation of these edges accomplished so that they fit into each other,

groove for groove. As the tendons have become very tense during the previous ten days or two weeks, they act as a rigid support, holding the bones in position by forcible contraction, thus obviating

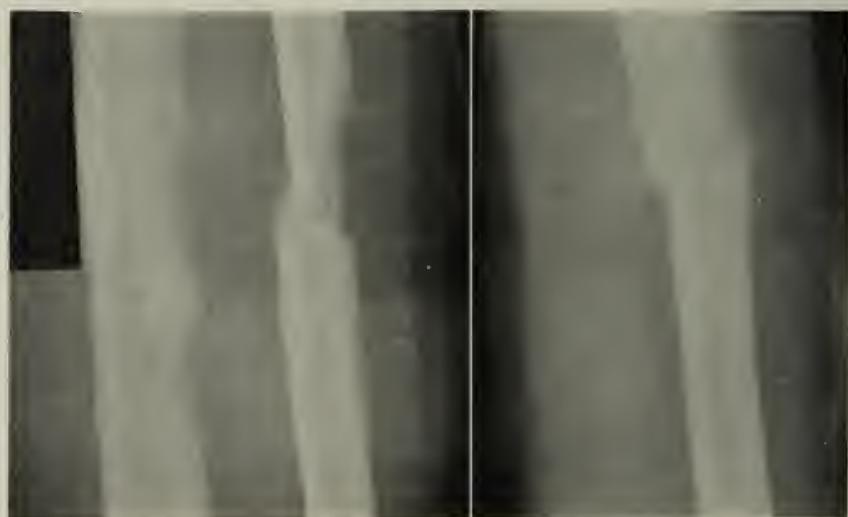


FIG. 171.

FIG. 172.

Figs. 171 and 172. Open operation showing simple locking of radius by serrated edges.

the necessity for the introduction of such foreign material as plates, wires, screws, etc. The tissues are then closed and a posterior molded plaster cast applied, which is allowed to remain on for six to eight weeks, and occasionally longer. Passive and active motion is then instituted for a month or six weeks, or longer.

Oblique Fracture of Both Bones. When the fractures are oblique and cannot possibly be held by ordinary methods, I use a fine intra-medullary beef-bone peg (see Figs. 160 to 165), thereby eliminating all metal friction.

COMPLICATIONS. The two most important complications are *operative infections* and *failure of the bones to unite*.

The ulna, in my experience, is the bone most subject to non-union. When a foreign metal substance, however, is used in either the radius or the ulna, it interferes materially with union in either bone. Poor or fair alignment obtained by the closed method and followed by fairly good functional results can well be regarded a desirable goal when one stops to consider the frequency with which an open operation, with the insertion of foreign metal material



FIG. 173. Method of determining non-union in radius and ulna.

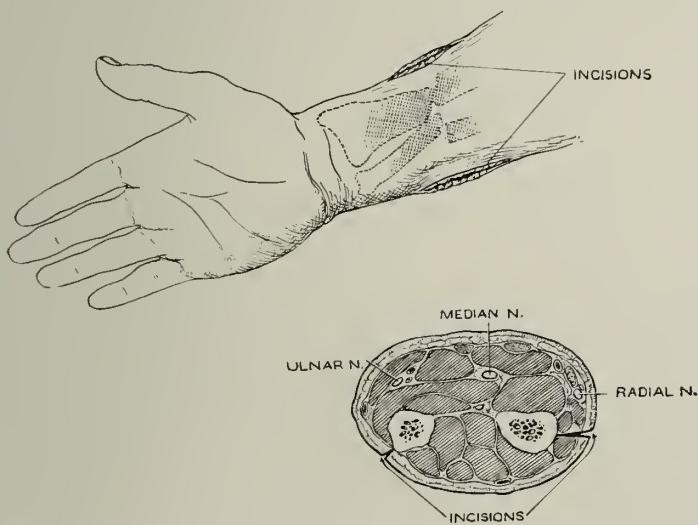


FIG. 174. Method of approach to bones of lower forearm to avoid important structures.

in the effort to attain perfect alignment, is followed by non-union and possible osteomyelitis.

PROGNOSIS. Total disability in the uncomplicated cases will

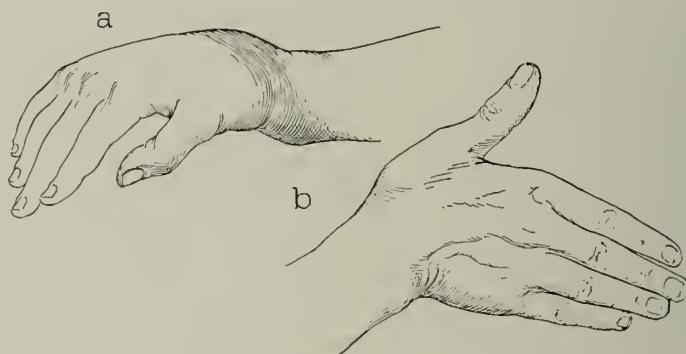


FIG. 175. Pistol splint position for Colles' fracture showing effect of eliminating adduction deformity.

extend over a period of four months and partial disability will be present for another month or six weeks.

COLLES' FRACTURE

SYMPTOMS. The invariable symptoms of Colles' fracture are swelling, deformity and spasm. Crepitus may or may not be present, depending upon whether or not the fracture is impacted. The usual deformity is of the silver-fork variety, caused by a backward rotation of the distal fragments; but as this is not always the rule, roentgenograms should be made in confirmation of the diagnosis. Nearly always there is marked prominence of the ulna over the styloid process, due to a shortening of the long axis of the radius.

This injury is often the result of cranking an automobile, the back-firing of the engine causing the handle to fly back and forcibly hyperflex or extend the hand on the wrist. Sometimes the injury is caused by falling on the hyperextended hand. It is quite unnecessary to illustrate a great variety of fractures, because Scudder and Cotton in their books* have amplified them thoroughly.

* Scudder, C. L. *The Treatment of Fractures*. Ed. 10. Saunders, Phila., 1926.
Cotton, F. J. *Dislocations and Joint Fractures*. Ed. 2. Saunders, Phila., 1924.

TREATMENT. This injury is such a common one that it is unnecessary to go fully into details as to the method of reduction. I suggest that the reduction be made to conform to the normal contour of the wrist joint. Whether displacement of the distal fragment is backward or forward, a special effort must be made to bring it into proper alignment. A very simple method of reduction is first hyperextension, then rotation toward the radial side with traction, then flexion followed by extension from the radial side in the pistol splint position with slight flexion and the pistol splint position maintained either with a metal form or a molded cast. When Colles' fracture is properly reduced, there need be no difficulty in obtaining full flexion of the wrist without any forcible effort. Also, when the reduction is properly done, pain is immediately reduced to a minimum.

After reduction the old pistol splint position (Fig. 175) is the preferable one. In some cases I have placed the arm in other positions which resulted in good alignment, but later there was some degree of adduction of the hand to the wrist with a more or less marked prominence of the lower end of the ulna (Figs. 176 to 182). This deformity was due to the fact that, although the lateral deformity was reduced, an impaction was allowed to remain, which resulted in a shortening of the long axis of the radius, with adduction of the hand, naturally bringing the ulna into prominence. A breaking-up of an impaction and the bringing of the bone into correct alignment and holding it there by means of the pistol splint method would have prevented this deformity.

After reduction preferably a posterior molded plaster cast, or two pieces of board, well padded and maintained with adhesive and bandage, or a metal pistol splint can be used to maintain the pistol splint position. Early passive motion is imperative in this form of fracture. Within ten days to two weeks after the accident the fixed dressing should be removed by the physician himself, the wrist manipulated a few times and the dressings replaced. This should be repeated every other day. Three to four weeks after the accident the fixed dressing is permanently removed and passive and active massage instituted. If the comminution is severe do not remove the fixed dressings under three weeks. At the end of the second week, however, passive and active massage can be used. The fixed dressing should not immobilize the fingers; they should be left free so that

early and frequent motion can be carried out, thereby preventing edema and fibrosis of the fingers as well as keeping the wrist more flexible.



FIG. 176.



FIG. 177.

FIGS. 176 and 177. Colles' fracture improperly reduced, showing shortening of long axis of radius.



FIG. 178.



FIG. 179.

FIGS. 178 and 179. Same case as Figures 176 and 177, two months later, still showing deformity.

There are numerous other accepted methods of reduction and treatment; but I have now limited myself to this method because of more uniform results.

Physicians are likely to keep on the fixed dressings beyond the period of good judgment, in order to obtain good appearance of the wrist. Such a course results in varying degrees of fibrosis and con-

FIG. 180.



FIG. 181.



FIG. 182.



Figs. 180-182. Same case as Figures 176-179, showing prominence of ulna and abduction deformity.

sequent loss of function. In some cases, particularly in old people, appearance should be sacrificed in the effort to obtain good function by means of early mobilization.

PROGNOSIS. Total disability will last three to four months, or slightly longer, and partial disability will last six to eight weeks, with always some question of ultimate specific loss.

BARTON'S FRACTURE

Barton's fracture of the posterior surface of the lower articular extremity of the radius is characterized by pain, swelling, posterior



FIG. 183.



FIG. 184.

Figs. 183 and 184. Colles' fracture with slight abduction deformity.



FIG. 185.



FIG. 186.

Figs. 185 and 186. Same case as Figures 183 and 184, four weeks later, following use of pistol splint position.

deformity, muscle spasm, limitation of motion and occasional crepitation. The same symptoms are present in *reversed Bartons' fracture* (fracture of the anterior surface of the radius). The diagnosis is readily confirmed by the roentgenogram. Treatment of both types of Barton's fracture is the same as for Colles' fracture (p. 128). Total disability lasts for two to three months, although full motion may not be regained for several months.

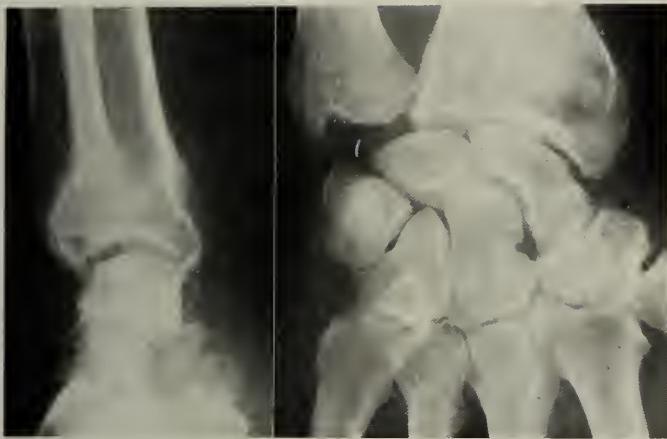
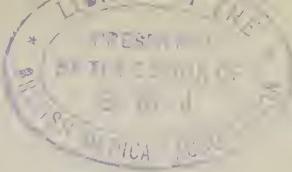


FIG. 187.

FIG. 188.

FIGS. 187 and 188. Same case as Figures 183-186, two months later, showing results following use of pistol splint position.



FIG. 189.

FIG. 190.

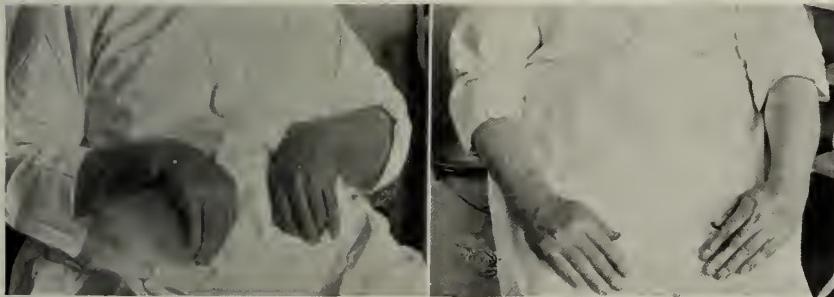


FIG. 191.

FIG. 192.

FIGS. 189-192. Same case as Figures 183-188, showing amount of adduction, extension, flexion and abduction, respectively.



FIG. 193.

FIG. 194.

FIGS. 193 and 194. Colles' fracture with slight abduction deformity.

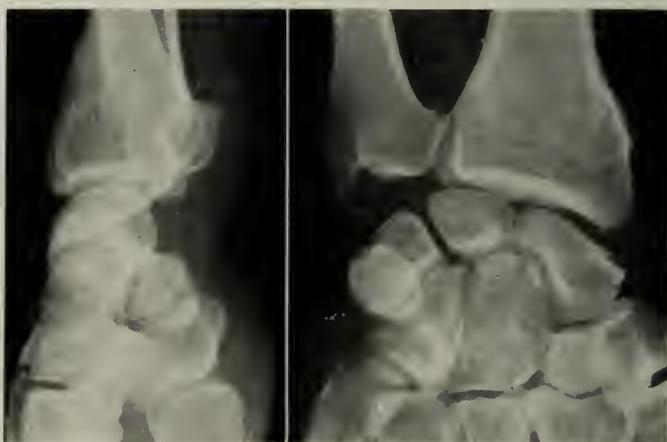


FIG. 195.

FIG. 196.

FIGS. 195 and 196. Same case as Figures 193 and 194, eight months later, showing result of pistol splint reduction.



FIG. 197.



FIG. 198.



FIG. 199.

FIGS. 197-199. Same case as Figures 193-196, showing absence of abduction deformity, amount of extension and amount of flexion.

CHAPTER VIII

INJURIES OF THE WRIST AND HAND

DISLOCATION OF THE SMALL BONES OF THE WRIST

DISLOCATION of the small bones of the wrist is usually caused by direct violence to the outstretched hand; it is sometimes the result of a crushing injury. The dislocation usually involves the semilunar, occasionally the os magnum; in rare cases it is so complete that the distal row lies on top of the proximal row of carpal bones, or vice versa.

DISLOCATION OF THE SEMILUNAR OF THE WRIST

SYMPOTMS. This common and easily overlooked injury, which is almost always anterior in type, is characterized by swelling, particularly on the anterior surface of the wrist at the base of the thumb, by marked spasm on extension and by limitation of flexion, abduction and adduction. Also very often there is a tingling sensation along the median nerve, and in old cases a definite median anesthesia and paralysis.

As for confirmation of the diagnosis by the roentgenogram, the lateral view is the only one that will satisfactorily diagnose this lesion, for, except to one thoroughly familiar with the articulations of the wrist bones, the anteroposterior view shows nothing of significance. In the lateral view, on the contrary, the displacement in front of the wrist joint is clearly shown, with the concave surface of the semilunar lying free instead of articulating with the os magnum, as in the normal wrist (Fig. 200).

TREATMENT. If the diagnosis is made within twenty-four to seventy-two hours after injury, the surgeon may attempt reduction of the dislocation by manipulation, with the patient under a general anesthetic. This type of dislocation, however, is never easy to reduce, even immediately after the injury. Because the chances of failure are great, *the surgeon should have a thorough understanding with the patient, before anesthetization, that if the dislocation cannot be reduced by manipulation, an open operation for reduction may be performed immediately.*

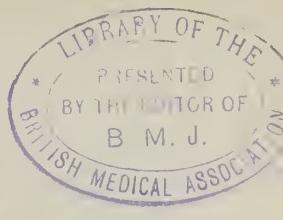


FIG. 200. Dislocation of semilunar bone, showing necessity of lateral view.



FIG. 201.



FIG. 202.

Figs. 201 and 202. Dislocation of semilunar bone showing importance of lateral view as compared with anteroposterior.

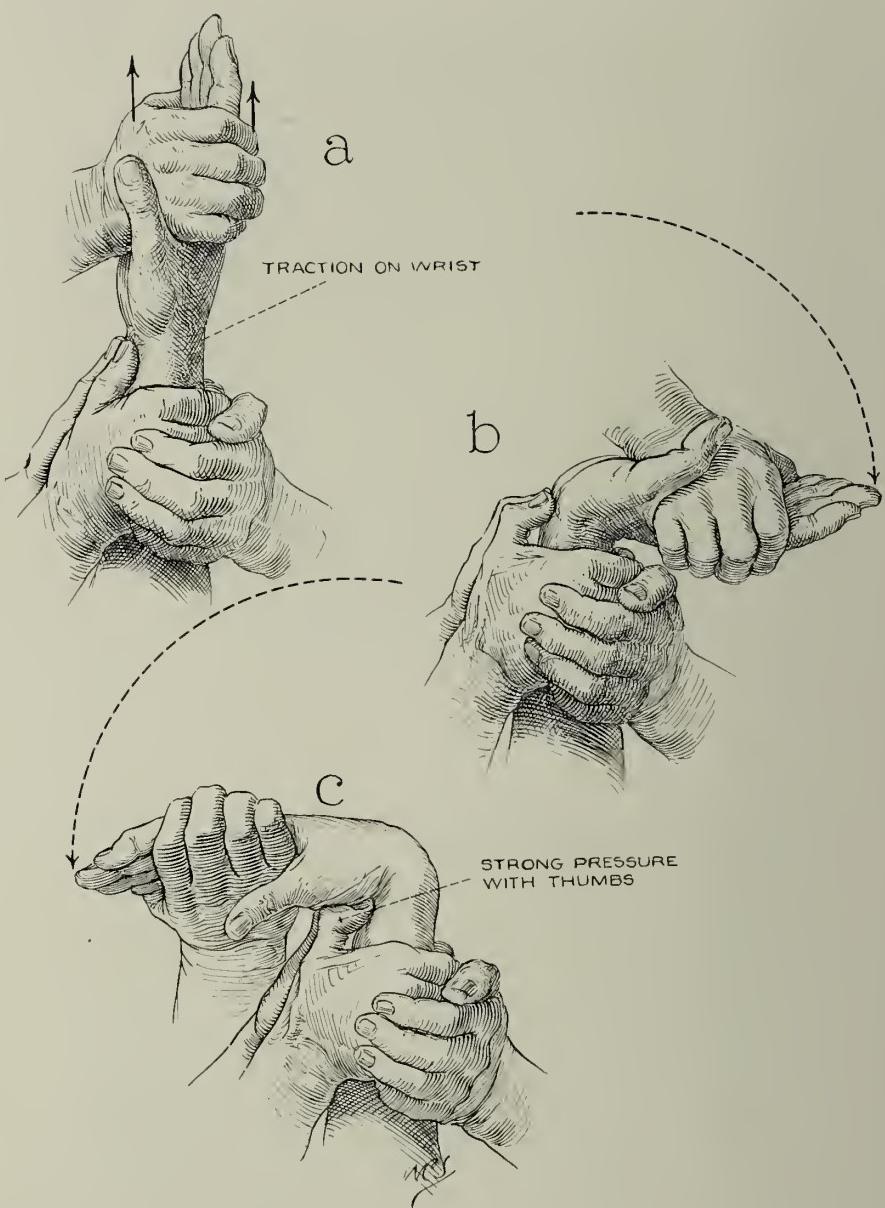


FIG. 203. Method of reduction of dislocated semilunar bone. a. Strong traction by operator, assistant's thumbs over semilunar. b. Full dorsiflexion continuing traction. c. Full palmar flexion over assistant's thumb as fulcrum.

When the patient has been completely anesthetized (a general anesthetic is desirable because it permits the greatest degree of muscular relaxation), the wrist should first be hyperextended,

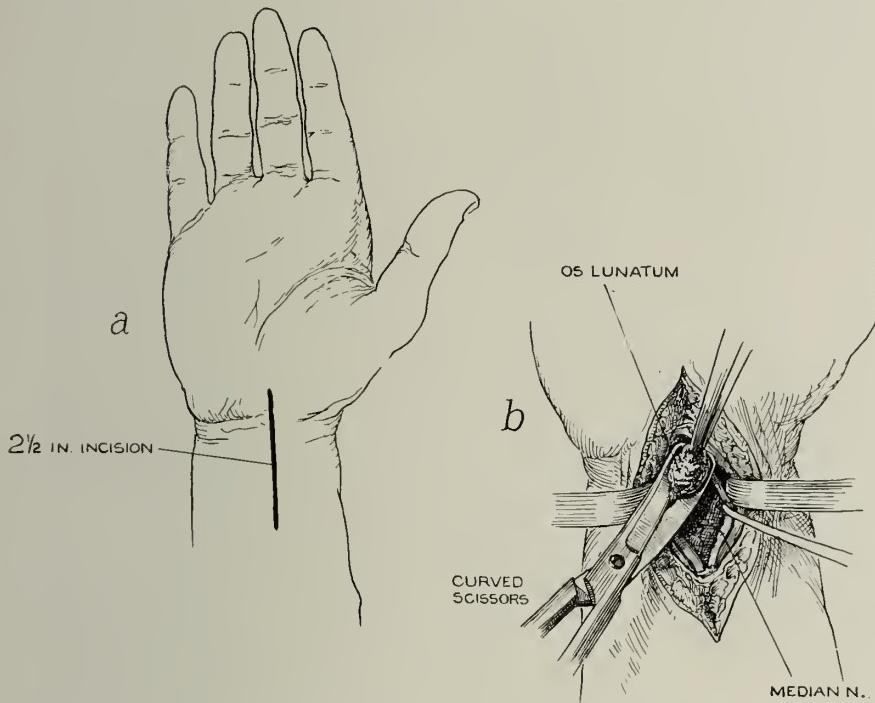


FIG. 204. Resection of anterior dislocation of os lunatum, showing how to avoid median nerve.

the surgeon pressing with his thumbs over the semilunar. Then the hand should be markedly extended and gradually flexed on the forearm. Where a closed reduction can be obtained but straight extension or even a little hyperextension causes it to dislocate again, it is advisable to dress it temporarily in flexion, holding it in that position for two and one-half to three weeks, which is sufficient time for ligamentous tissues to heal. After this, institute passive massage. If, after two or three attempts, this method of manipulation is not successful, an open operation is performed. An incision on the anterior surface, extending to the inner side of the flexor pollicis longus, permits good exposure (Fig. 204). The surgeon should be sure of his

anatomy, since the median nerve may be easily injured when the incision is made, and a distressing complication result. Following reduction and closure of the tissues the wrist should be slightly extended upon the forearm, so that if infection or fibrosis follows, the ability of the hand to grasp or hold is not so greatly impaired as when the wrist is fixed in flexion. A posterior molded plaster splint is then applied.

At the end of ten days to two weeks the splint may be removed temporarily and passive motion employed every day, or at least every other day, for the next ten days or two weeks. The splint may then be removed entirely and both active and passive motion practiced. The degree of limitation of motion—in nearly all cases there will be some limitation—depends considerably upon the cooperation of the patient in the performance of these movements.

If the patient delays coming for treatment until some time after the date of injury, the chance of reducing the dislocation by manipulation or by open operation is slight because of the filling in with fibrous tissue of the space formed by the dislocation. In such a case, should reduction prove impossible, the semilunar must be removed. After operation a bandage is all the support necessary, and passive motion should be instituted within seventy-two hours. In closing these tissues one must be careful in replacing the median nerve to see that it is in a smooth bed so that adhesions will not form about it; otherwise one is very likely to see a median causalgia develop (p. 141).

PROGNOSIS. Total disability lasts from ten to twelve weeks, and partial disability extends over another four to six weeks. The patient is nearly always left with some degree of limitation of movement. In the cases in which the median nerve is injured, the disability period may be relatively longer, depending upon the severity of the nerve lesion.

DISLOCATION OF THE OS MAGNUM

The symptoms, treatment and prognosis of this type of dislocation are identical with dislocation of the semilunar.

Although there are on record dislocations of other single carpal bones besides the semilunar and os magnum, I have not encountered any in a practice extending over twenty-six years.

DISLOCATIONS OF THE CARPAL ROWS ON EACH OTHER

SYMPTOMS. These dislocations are accompanied by pain, deformity, muscle spasm, marked limitation of motion and occasionally crepitus and distortion. In appearance they resemble Colles' fracture with silver-fork deformity, but the differential diagnosis can easily be made by means of the roentgenogram, particularly a lateral view.

TREATMENT. If the condition is diagnosed within twenty-four to thirty-six hours after injury, reduction may be easily effected by hyperextension combined with flexion and extension of the wrist as in a dislocation of a semilunar (see Fig. 203). After reduction, if fixed dressings seem advisable (although usually padding and a bandage will suffice) the hand should be placed slightly in extension upon the forearm, since this position, in the event of fibrosis, does not interfere with grasping power as does the position of flexion. Passive motion should be started within ten days to two weeks after reduction, and active motion may be begun after five or six weeks.

A median or ulnar nerve lesion, due either to direct injury or pressure, may prove a troublesome complication to treat (p. 140).

In unrecognized cases in which a month or more has passed without treatment, reduction is difficult because of the presence of fibrosis and adhesions together with possible fractures. In such cases an open operation for excision of the proximal row is the only form of treatment. It is remarkable, even where neither the proximal nor the distal row is removed, how much compensatory motion develops with no peripheral nerve complication in some cases.

The surgical approach for removal of carpal bones is best made by making one incision perpendicular and to the thumb side of the median nerve and another one to the thumb side of the ulnar nerve. In this way the danger of injury to vital soft structures is lessened.

PROGNOSIS. The entire period of disability lasts from three to five months, and is usually followed by a varying degree of limitation of motion.

FRACTURES OF THE CARPAL BONES

This condition is far from being uncommon and is usually the result of a direct injury such as a fall on the outstretched hand.



FIG. 205. Transverse fracture of scaphoid bone.

FRACTURE RECORD

Name D.J.	Address	Case No. 8591	
Age 34 Sex M	M.S.W.D.	Date Hr.	
Occupation LABORER		Dr.	
Cause of Fracture FELL LANDING ON EXTENDED LEFT HAND		Time of Occurrence of Accident 12-6-27	
		Hospital Entered	
		First Treatment	
		X-Ray No 33742	
EXAMINATION		TREATMENT	RESULT
Bone SWELLING OVER DORSUM OF ENTIRE LEFT HAND, PAIN ON PRESSURE OR MOTION AT WRIST.		Closed Reduction Method and Position of Fixation COCKUP SPLINT. Abduction Used Yes No 3 WEEKS.	Good Moderate Bad
Joint Instability		Assisted by Abduction PHYSIOTHERAPY SINCE TENDER TO PRESSURE OVER CARPALS.	Description of End Result, including Deformity, Swelling, Function, Pain, Sensation, Nerve (a) At discharge from Hospital Date 2-7-28
Contracture		Open Reduction Method and Position of Fixation	MOTION IN LEFT WRIST 42° EXTENSION, 55° FLEXION, IN UNINJURED WRIST 42° EXTENSION, 68° FLEXION.
Description of Deformity including abscesses			(b) At discharge from O.P.D. Date
Nature and Extent of Injury to Soft Parts especially nerves and vessels			(c) At admission date Date
			Disability: Absent, Partial, Considerable
			Was anti-septic treatment tried first?
			How long after injury was operation performed?
			Was internal fixation material subsequently removed?
X-Ray TRANSVERSE FRACTURE OF SCAPHOID BONE		Why	Mortality Date
Before Reduction		When	Main cause of death
After Reduction		Period of Convalescence/Immobilization	Absence from work: Duration 69 DAYS
At Discharge		Period of Protection	*Ability to resume job
Wassermann Test		Total Period of Protective Treatment	*Present Wage earning capacity
			Compensation obtained: Yes? No?
			*Black Ink: Surgeon's Opinion Red Ink: Physician's Opinion

Form 194, A.C. & C. Co., Inc., Boston, Mass.

FIG. 206. Fracture record of case shown in Figure 205.

Sometimes it is a complication of a dislocation, occasionally from a backfire in cranking an automobile.

The bone most commonly affected is the scaphoid; then the semilunar; then os magnum. Others may become involved, but not to such a degree of frequency.

SYMPTOMS. There is a history of accident, local swelling, usually over the extensor surface, tenderness, definite muscle spasm on both flexion and extension and forced abduction and adduction. Occasionally, though rarely, there is crepitus. Roentgenograms are of vital importance and should be made from more than one angle, as sometimes the first one or two will not show the fracture.

TREATMENT. This consists in immediate immobilization using a splint or cast that definitely fixes the hand from the wrist down to the tips of the fingers. One should not be too hasty in removing this splint in order to resort to early motion. It is best to delay for seven to eight weeks because the circulation and blood supply to these bones are very poor; they are apt to undergo non-union through malnutrition and absorption of one or other of the fragments. The pain is likely to be persistent on motion, and occasionally before a complete cure can be obtained, a surgical removal of one or both fragments becomes necessary. This is especially likely where early treatment has not been conservative.

PROGNOSIS. For the above reasons the prognosis must be guarded and an estimate given of three to four months at least, and longer if extirpation is necessary. It is well to guard the prognosis by advising that occasionally surgical removal of one or both parts is necessary before a complete cure can be obtained. At times there is some limitation of motion as a permanent after-effect.

FRACTURES OF THE METACARPAL BONES

Fractures of the metacarpal bones may be diagnosed by the symptoms of swelling, localized pain, deformity, muscle spasm and crepitation. The diagnosis can easily be confirmed by the roentgen ray. Occasionally this will fail to show a fracture until after three or four days of persistent pain. Hence more than one roentgenogram should always be made, especially when pain persists. This applies to any bone.

TREATMENT. As this type of fracture can usually be reduced by manipulation, open reduction is an infrequent procedure. There are two practical methods of holding a reduced fracture of a metacarpal



FIG. 207.

FIG. 208.

Figs. 207 and 208. Fracture of scaphoid treated by fixation in cock-up splint.



FIG. 209.

FIG. 210.

Figs. 209 and 210. Same case as Figures 207 and 208.

bone in place: (1) the fitting of a hard roll of bandage into the palm of the hand, with the fingers flexed around the bandage (Fig. 212); or (2) the application of a banjo splint. This splint consists of a piece of metal fitting the anterior surface of the forearm from which

WRIST AND HAND

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an extension of round hard wire protrudes beyond the fingers to which can be attached any form of extension to any of the fingers. Du Puy has a good splint for these cases that can be used with

FRACTURE RECORD					
Name N.O.	Address		Case No.	86779	
Age 22 Sex M # M. S. W#7	White or Colored		Date	Mr.	
Occupation OILER			Hospital Entered	NONE	
Cause of Fracture FELL FORWARD ABOUT 10 FT. CATCHING WEIGHT ON HANDS EXTENDED			Time of Occurrence of Accident	1-11-28 4.30 P.M.	
			First Treatment	1-12-28	
			Final Reduction		
EXAMINATION		TREATMENT		RESULT	
Bone RIGHT NAVICULAR	Closed Reduction		Anatomical	Good	Moderate
Site BODY	Method and Position of Position		Functional	X	Bad
Type:	COCKUP SPLINT WRIST			X	
Sympt. Transverse X	Anesthetic Used	Yes		Description of End Result, including Disability, Swelling, Fatigue, Pain, Swelling, Nerve —OR—At discharge from O.P.D.: Date	
Capsular	Anatomical Result obtained			NO DEFORMITY. EARLY HEAT AND MASSAGE INSTITUTED. 2 WEEKS.	
Intra-Joint	Soleal				
Subluxated	Inverted				
Greenstick	Comminuted X		Open Reduction		
			Method and Position of Position		
Description of Deformity including shortening				(a) At discharge from O.P.D.: Date 3-9-28	
NONE				NO ATROPHY. FOREARM LIMITATION 5° DORSIFLEX HAN	
			Anatomical Result obtained		
Nature and Extent of Injury to Soft Parts especially nerves and vessels				(b) At subsequent date Date	
CONTUSION OF SOFT PARTS WRIST				Disability: Answer Partial-Caused	
				SPECIFIC FUNCTIONAL LOSS APPROXIMATELY	
				MATES 5%	
X-Ray			Way	Mortality Date	
Before Reduction NO DISPLACEMENT FRACTURES			Where	Main cause of death	
After Reduction 2-21-28 CALLUS FORMING			Period of Complete Immobilization	Absence from work: Duration	
			Period of Protection	Ability to resume job	
			Total Period of Protective Treatment	Present Wage earning capacity	
Wassermann Test				Compensation obtained: Yes? No?	
				Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 19-A, S. S. Case Record System
Futura Company, Chicago

FIG. 211. Fracture record of case shown in Figures 207-210. |

zinc oxide, adhesive or moleskin, etc., or acetone. If the banjo splint is used, an extension should be put on the finger and traction applied to the metacarpal bone. Such a splint, with extension and traction, not only gives good alignment but prevents stiffness of the joint by permitting motion in the metacarpal phalangeal joint. Either the roller bandage or the splint should be worn for four to six weeks, and then heat, massage and passive motion should be instituted.

In occasional cases these two methods of fixation fail to hold the reduced fracture in place, and a special type of extension splint must be employed. An acetone extension splint is very good in these cases. Take an old roentgen-ray film, cut it up into small pieces, add acetone solution and dissolve to the appearance and

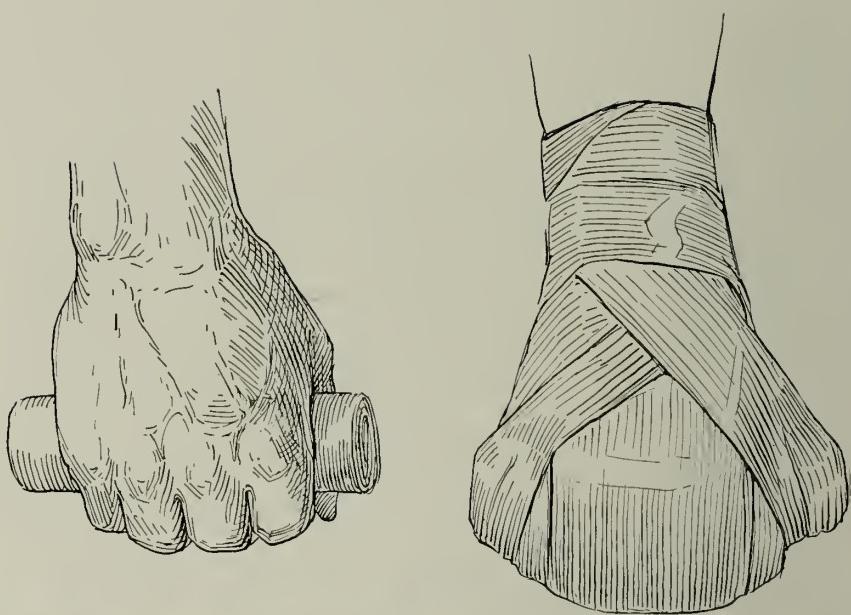


FIG. 212. Ball bandage for metacarpal fractures.



FIG. 213.



FIG. 214.

FIG. 215.

Figs. 213-215. Fracture of fourth metacarpal, showing necessity of two views. Patient a structural iron worker, aged twenty-five. On August 31, 1927, struck hand against iron wrench. Roentgenogram revealed simple oblique fracture of fourth metacarpal. Treated by extension and fixation over firm roll splint. October 15, 1927, discharged. No loss of motion. Lost ten days. Resumed normal job at end of four weeks at former wage.

consistency of glue. Then paint the finger and use a muslin bandage, sticking it to the acetone on the finger, letting it dry, then applying extension.

PROGNOSIS. Total disability lasts six to eight weeks and partial disability for another three to four weeks.

DISLOCATIONS OF THE PHALANGES AND METACARPALS

These common dislocations are so easily amenable to simple treatment that no discussion is necessary.

FRACTURES OF THE PHALANGES

Fractures of the phalanges are characterized by swelling, deformity, pain and crepitus. The diagnosis is easily confirmed by the roentgenogram.

TREATMENT. The application of a splint or a straight piece of wood such as a portion of a tongue depressor, or a hard roll of bandage (Fig. 212) as used in metacarpal fracture, is the only support necessary. The splint or bandage should be worn for only three or four weeks. An extension splint may be used in the rare cases in which the reduction is maintained only with difficulty, such as those referred to under fractures of the metacarpals. Massage should be started as early as the second and third week. The many methods used are very well described by Scudder.* My own method has been simplified to a ball bandage for metacarpals and a throat stick for fingers.

PROGNOSIS. Disability extends over a period of four to six weeks (total) and two to three weeks (partial).

* Scudder, C. L. *The Treatment of Fractures*. Ed. 10. Saunders, Phila., 1926.

CHAPTER IX

INJURIES OF THE RIBS

FRACTURES OF THE STERNUM

THIS injury is rare except in industrial accidents and is usually brought about by a crushing injury or direct violence.

SYMPTOMS. These are manifested by definite localized pain and definite interference in respiration (both inspiration and expiration) the complete cycle being suddenly stopped. Sometimes crepitus is present, and occasionally hemoptysis, shallow respiration and shock. Roentgenograms can sometimes confirm this fracture, although it takes an expert operator to get a view of the sternum and a fairly competent diagnostician to see it because of the confusion of osseous structures.

TREATMENT. In the upper two segments the best method is the use of the Valentine clavicle splint, which pulls the shoulders back, taking the weight of the chest off the sternum. This, together with a high body binder, will suffice. Keep the patient in Fowler's position constantly, treating for shock and hemorrhage with morphine and atropine, watching elimination, forcing liquids and using light diet.

Occasionally adhesive strapping is recommended, using wide strips and following the contour of the chest as in fractured ribs.

COMPLICATIONS. The complications to be expected are traumatic pneumonia and pleurisy, hemorrhage and shock, occasionally tuberculosis of the sternum or syphilitic osteitis. At the present time I have a definite case of tuberculosis of the sternum following a comparatively simple trauma.

PROGNOSIS. Disability will be three to four months, in uncomplicated cases.

FRACTURED RIBS

This type of injury is caused by direct violence; either a fall or a blow upon the chest. Only rarely is a strain sufficiently great to produce fracture. The treatment of all fractured ribs, regardless of anatomical position or the simple or compound nature of the fracture, is identical.



FIG. 216. Lateral view of chest wall showing fracture of sternum at junction of manubrium and gladiolus.

SYMPTOMS. Pain, either on inspiration or expiration, or both, with sudden checking of the full respiratory cycle, is a marked symptom. Pain can also be localized in the region of the fracture by



FIG. 217.



FIG. 218.

FIGS. 217 and 218. Practical method of strapping ribs by following contour of the ribs. Note high strapping on back and low in front.

palpation. Upon repeated palpation tenderness is found to be marked over a definite and *unvarying* area. Occasionally there is crepitation. Hemoptysis indicates severe injury, with involvement of the pleura or lungs. The degree of hemoptysis depends upon the degree and extent of the lung tissue injury. There is always extreme discomfort upon lying down, whether the fracture be simple or compound.

The roentgenogram, in addition to these symptoms, is important in making the diagnosis certain. Stereoscopic films are valuable in showing penetration of lung tissue.

TREATMENT. Cases without Pleura or Lung Penetration. The main part of the treatment of cases in which lung tissue is unpunctured consists in strapping of the chest. In applying the adhesive strapping, the surgeon must keep in mind the fact that the ribs attach to the spine at a much higher point than to the sternum. If he applies the adhesive so that it follows the course of the ribs (Figs. 217, 218), he will bring much greater relief to his patient than if he applies the adhesive in a straight line around the chest. The adhesive straps should overlap each other and extend at least two ribs below

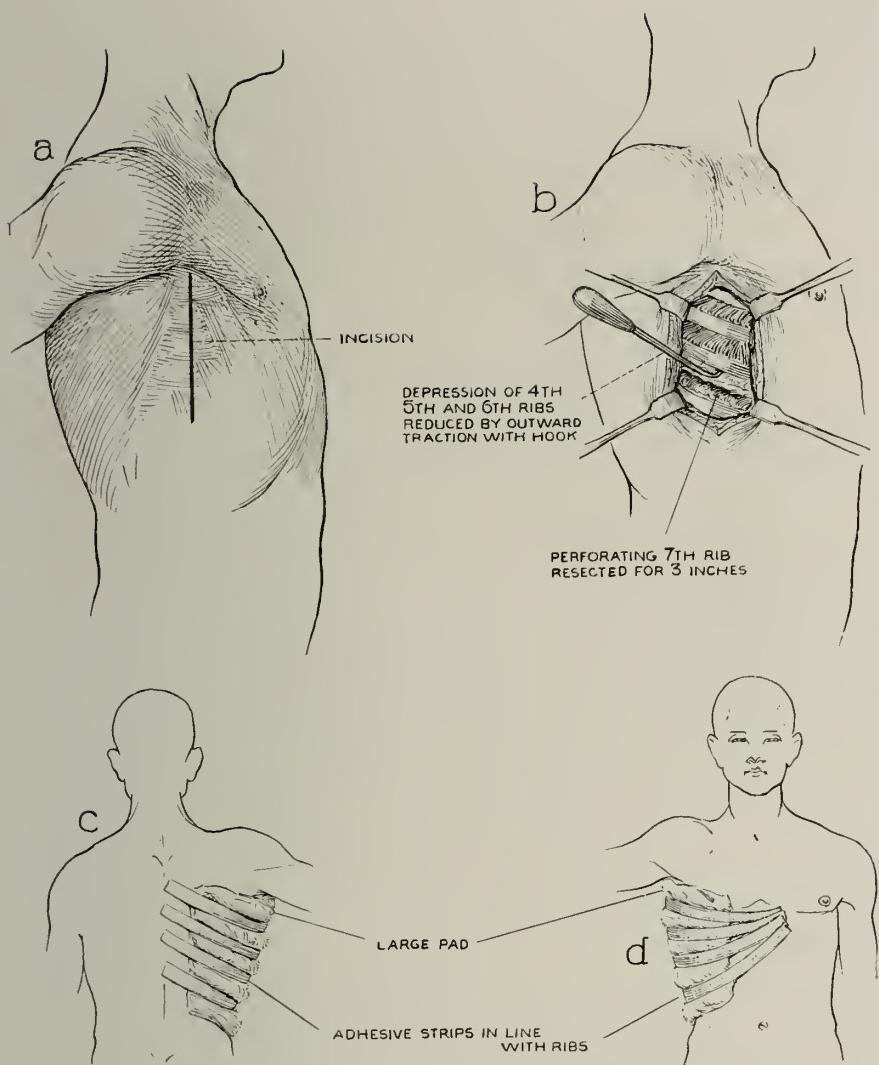


FIG. 219. Treatment of fractured ribs penetrating lung.

and two ribs above the affected area and also well across the median line behind and in front, thus restricting excursion of the injured side.

Position of Patient Following Strapping. Following application of the adhesive, emphasis should be laid on the point that when the patient goes home (as a rule, these patients are not hospitalized) *he must not attempt to sleep in a horizontal position, but must keep a sitting position or remain in Fowler's position.* He must, later, rest in a rocking chair or a Morris chair. If he follows this instruction he will help his physician ward off pulmonary complications, active or passive.

The adhesive strapping must be worn and the horizontal position avoided for two weeks or more, depending on the extent of the fracture.

Treatment of Cases with Pleura or Lung Penetration. These cases should first be treated for shock and operation performed as soon as possible for removal of the portion of the fractured rib which has pierced the pleura or the lung tissue. Since in this injury fracture involving the lung is likely to cause lung abscess and also lung congestion, early surgical removal of the rib or ribs penetrating the lung tissue assumes great importance. Such an operation can be done under local anesthesia and should cause no ill effects due either to removal of any part of the rib or to infection. Mercurochrome can be used even in the lung substance itself, without harmful results.

PROGNOSIS. In simple fractures without complications, disability extends over a period varying from three or four weeks to eight or ten weeks, depending upon the number of fractures and the nature of the patient's occupation. In even uncomplicated cases, however, one must be guarded in prognosis because of the ever-present possibility of passive or active lung congestion. In tuberculous patients or patients with a family history of tuberculosis, prognosis must be made with extreme caution.

In cases showing lung penetration, the possibility of lung abscess, in addition to the danger of lung congestion, must be considered in making a prognosis.

COSTOCHONDRAL SEPARATION OF THE RIBS

This condition, like fracture of the ribs, is usually due to direct violence and only very rarely to strain. It involves the ribs only at

their cartilaginous junction with the sternum; therefore, symptoms of lung perforation do not complicate the picture as a rule.

SYMPTOMS. The symptoms are identical with those of fractured rib without lung penetration plus the additional symptom, upon palpation, of definite crepitation with a slipping sensation at the junction of the rib with the cartilage.

The roentgenogram is of no value in diagnosis, because it cannot show a cartilaginous lesion.

TREATMENT. The treatment is identical with that of a fractured rib (p. 150).

PROGNOSIS. The period of disability depends upon the line of employment followed by the patient. In a man doing heavy manual labor it may be estimated at four to six weeks or longer, depending upon the extent of the injury.

CHAPTER X

SPINAL INJURIES*

THE ROENTGENOGRAM IN SPINAL INJURIES

MANY physicians think that roentgenograms of the spine need be made only in cases of apparently severe injury, for the reason that a slight injury cannot possibly damage the spine.

This attitude is an incorrect one. Although many slight injuries in themselves cause no serious spinal trouble, they may be the means of aggravating a preexisting spinal anomaly or a pathological condition such as arthritis, tuberculosis or syphilis. If roentgenograms are taken *immediately* following *all* spinal injuries, the presence of such anomalies or diseased conditions may be recognized or ruled out or in and the proper means of treatment immediately instituted. (The legal importance of the roentgenogram in similar cases is discussed in Chapter II.)

Then, too, there is always the possibility that an apparently slight injury may cause a fracture which at first exhibits no pronounced symptoms or bone changes but which, after weight-bearing has placed pronounced strain on the line of fracture, exhibits all symptoms of a serious lesion (compression fracture). (Kümmell's disease.)

A good working knowledge of osteology and pathology is an obviously necessary equipment to a roentgen-ray diagnostician who is called upon to differentiate between normal and pathological spinal conditions. However, such knowledge is of little value if he does not take roentgenograms from angles that show the lesion.

* Since detailed anatomical descriptions and extensive discussion of clinical findings are out of place in this volume, the reader, if he wishes to go into further detail, is referred to the following books on various aspects of spinal injuries, anomalies and pathological conditions:

George, A., and Leonard, K. The Vertebrae, Roentgenologically Considered. Hoeber, N. Y., 1929.

Kleinberg, S. Scoliosis. Hoeber, N. Y., 1926.

Frazier, C. H. Surgery of the Spine and Spinal Cord. Appleton, N. Y., 1918.

Stewart, W. H. Skull Fractures Roentgenologically Considered. Hoeber, N. Y., 1925.

Baetjer, F. H., and Waters, C. A. Injuries and Diseases of the Bones and Joints. Hoeber, N. Y., 1921.

United States Army X-Ray Manual. Hoeber, N. Y., 1925.

Anteroposterior and lateral views should always be included. Stereoscopic films are of value. Frequently an anteroposterior view of the spine fails to show the presence of a fracture that is clearly



FIG. 220. Sacralized transverse process of 5th lumbar vertebra often misdiagnosed as a fracture by those not trained in defining bone anomalies.

indicated in a lateral view. If a sufficient number of views are taken, there is no reason for confusing a sacralized transverse process of the fifth lumbar vertebra with a fracture. In order that such diagnostic errors, of serious consequence to patient, physician and employer, may be avoided, I again emphasize these points: *Make roentgenograms in all cases of spinal injury and take them from at least two different angles.*

SPINAL ANOMALIES AS COMPLICATIONS OF SPINAL INJURIES

Anomalies of the spine are not caused by trauma, but may merely be aggravated by it. The roentgenogram is important, from both a diagnostic and a legal standpoint, in determining the presence, either active or latent, of spinal anomaly before the occurrence of spinal injury.

Four important types of spinal anomalies may be mentioned: First, the seventh cervical rib, which causes local pain or referred pain in the arm, in the region of the brachial plexus. Personally, I do not think trauma ever aggravates this condition. Second, it is not uncommon to find a sacralized transverse process of the fifth lumbar vertebra, on one or both sides. In such a case, the transverse process has become incorporated with the sacrum (Fig. 220). Trauma may aggravate this slowly developing condition by causing tearing of the erector spinae muscles. Pain, both localized and reflex, is a marked symptom of the condition. Sometimes such cases are wrongly diagnosed as compression fractures. Third, occasionally wedged vertebrae are found; however, one must be sure that the case is one of wedged vertebra and not a compression fracture. Wedged vertebrae are congenital and affect only one side of the body. They are more apparent in the anteroposterior view by roentgen ray. Fourth, spina bifida is again a congenital malformation and may be misinterpreted by the inexperienced.

SEVENTH CERVICAL RIB

SYMPTOMS. The symptoms will be localized pain, muscle spasm, and rigidity with pain radiating down the arm, usually persistent in character. A roentgenogram may show an unusually large rib.

TREATMENT. Notwithstanding my personal opinion that trauma does not aggravate the conditions brought about by the presence of a seventh cervical rib, it may be necessary at times for a traumatic surgeon to treat this condition. In many instances, he will find that rest, heat, diathermy and massage give relief; in rare cases, the rib must be removed before relief can be obtained.

PROGNOSIS. If a patient is treated for a cervical rib condition that is supposedly aggravated by trauma, he may usually return to work in three or four weeks. If the cervical rib must be removed, if such a condition as arthritis complicates the picture, the disability period is indefinitely prolonged.

SACRALIZED TRANSVERSE PROCESS OF FIFTH LUMBAR VERTEBRA

SYMPTOMS. These will be localized pain, muscle spasm, more or less continuous pain on movement radiating down the leg on its

posterior aspect, and inability to get about without discomfort, though all may not be apparent at the same time. Roentgenograms will show definite anomaly.



FIG. 221.

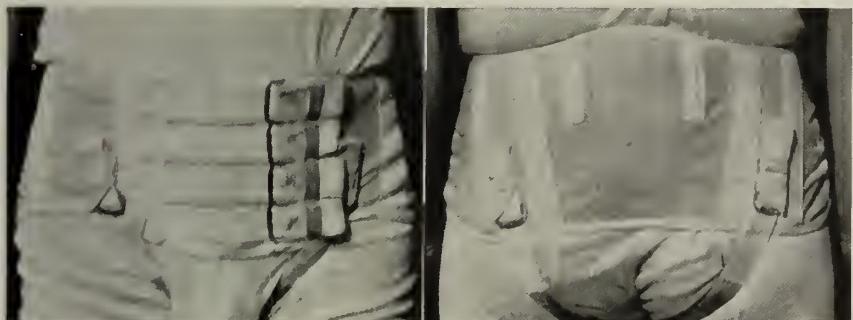


FIG. 222.

FIG. 223.

FIGS. 221-223. Goldthwait belt.

TREATMENT. In cases of a sacralized transverse process of the fifth lumbar vertebra aggravated by trauma, rest, heat, diathermy and massage may prove effective. Immediate absolute rest in bed for two weeks, in a position of hyperextension, is sometimes sufficient. Occasionally, a Goldthwait belt must be applied. If, however, none of these measures is effective, the question of wrenching the back must be considered. This applies particularly to the chronic cases in which the erector spinae muscles are torn. Wrenching should be done only after the other forms of treatment have been

FIG. 224.



FIG. 225.



FIG. 226.



FIG. 224. Manipulation of spine under general anesthesia for chronic low-back pain. Operator's knee against small of back, forcibly flexing body backward over knee

FIG. 225. Operator's knee against abdomen, flexing body over knee.

FIG. 226. Assistant holding pelvis fixed, forcibly flexing body sidewise to right, then to left, from shoulders.

given a thorough trial and after careful roentgenological studies and physical examination have eliminated the possibility of a pathological condition that might be aggravated by wrenching; e.g., arthritis of long standing, tuberculosis or syphilis.

Wrenching is done under general anesthesia. After the operation the patient is kept in bed for a week or ten days, or even two weeks. Gradual weight-bearing may then be begun, and if necessary diathermy and massage instituted.

For the few cases that do not improve after the back has been wrenched, surgical removal of the sacralized transverse process has been attempted by some surgeons in the hope of relieving a possible mechanical pressure on the nerves. I consider this operation questionable, for I have seen little relief obtained after performing it; in discussing it with orthopedic men who have performed the operation I find they do not seem satisfied that the work and end-results pay. A Hibbs fusion or an Albee transplant might be more practical.

PROGNOSIS. If rest, heat, diathermy and massage are the only methods of treatment necessary to cure a case with a sacralized transverse process of the fifth lumbar vertebra, the patient may return to work in three or four weeks. If the back must be wrenched, the patient may return to work in six to eight weeks after the wrenching. Prognosis should be guarded, however, in all cases of injury involving spinal anomalies, since the question of such complications as arthritis, tuberculosis or syphilis may extend the disability period into months.

PATHOLOGICAL CONDITIONS OF THE SPINE AGGRAVATED BY INJURY

Under this heading we can include a number of conditions such as spondylitis deformans, tuberculosis, syphilis, sarcoma and arthritis. There are many instances in which the patient gives a history of a comparatively simple injury to the back, but in which the symptoms are out of proportion to the severity of the injury: increasing diffuse pain along the back, muscle spasm, rigidity, loss of mobility of the spinal column. The roentgenogram may reveal an arthritic process that has been aggravated by the injury, showing an increased deposit of bone along the spinal column, with a lipping of the bodies; or it may show the definite changes in the osseous

structure, chiefly in the bodies of the vertebrae, characteristic of an aggravated tuberculous or syphilitic lesion.

TREATMENT. In such cases there should be no hesitation about



FIG. 227.



FIG. 228.

FIGS. 227 and 228. Lateral and anteroposterior views of multiple hypertrophic arthritis of spine, vertebrae in Figure 228 showing extensive fusion of hypertrophic spine.

the method of treatment. The whole spine should be immobilized by means of a plaster cast, a Taylor spine brace (Figs. 229, 230) or a good body binder. Special attention should then be paid to the patient's history of previous affections, such as rheumatism, tuberculosis, etc., and a thorough investigation of his physical makeup should be made. The blood should be examined and infected teeth or tonsils should receive prompt attention and be treated symptomatically.

PROGNOSIS. There is no possible way of estimating exactly the period of disability. The extent of the pathological lesion, the general physical findings and the age of the patient are all important factors

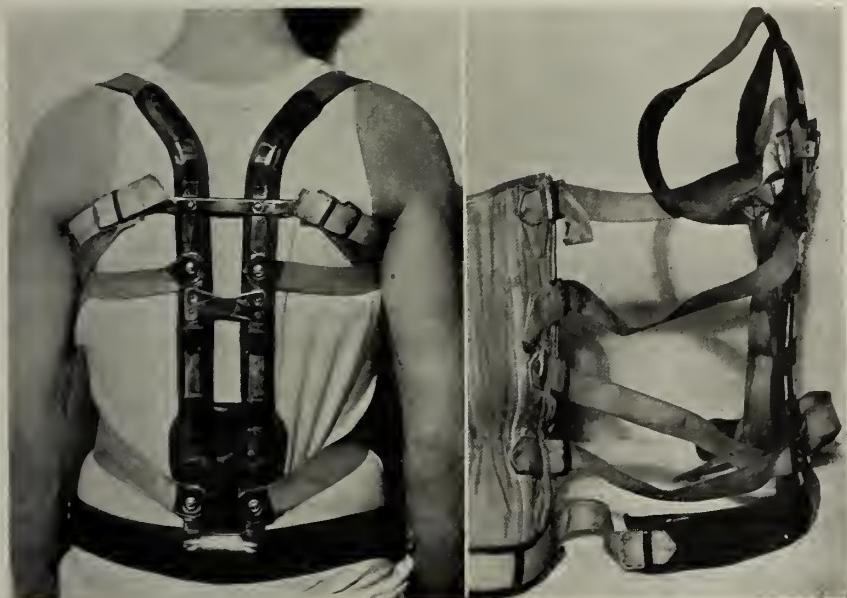


FIG. 229.

FIG. 230.

FIGS. 229 and 230. Taylor spine brace.

and should be carefully considered. To err through overestimation is more satisfactory than to make an optimistic but doubtful statement as to the length of the disability period.

CONCUSSION OF THE SPINE

SYMPTOMS. This common injury, which is usually the result of a fall causing direct violence to the spinal column, is characterized by inability to get about with any degree of comfort, by a localized area or areas of tenderness on deep pressure, and by pain upon bending over or upon assuming an upright position, with inability to bend sidewise and backwards. There are rigidity and muscle spasm not distinctly localized. Occasionally there is a feeling of general muscular soreness along the entire back. These patients complain of continuous aching, usually not noticeable at first but steadily increasing

FIG. 231.



FIG. 232.



FIG. 233.

FIGS. 231-234. Two methods of strapping the back.

FIG. 234.

in degree. From the symptomatology, injury to the osseous structure may be suspected, but the roentgenogram eliminates the question of bone injury.

TREATMENT. Various forms of treatment are advocated, but the one I have found most satisfactory is immediate diathermy combined with direct heat and the intelligent application of Swedish massage. For the first three or four days after injury, the treatment should be given daily, and then on every other day. When this method of treatment is followed, the patient need not be kept in bed; in fact, it is preferable that he be kept actively moving. Often the treatment will take only a week or ten days, but in some cases four to six weeks of treatment may be necessary.

The massage must be intelligently given or the patient will derive little benefit from it. A Stockholm graduate is one of the best fitted for this work.

When diathermy and massage are not practicable, adhesive strapping of the back must be done (Figs. 231-234). The patient should be kept in bed for ten days to two weeks before strapping, and local heat should be applied. Internal medication and, if possible, eradication of foci of infection help to shorten the period of treatment. The adhesive strapping must be kept on for three to six weeks.

PROGNOSIS. Five to six weeks is the average period of disability in the cases treated by diathermy and Swedish massage. When adhesive strapping is applied, the disability period extends over one and one-half to two or three months. Focal infections may prove troublesome complications, extending the disability to two or three months or longer.

FRACTURE OF THE CERVICAL SPINE

This unusual injury may be divided into two classes, according to symptomatology: (1) fractures with no cord symptoms, (2) fractures with cord symptoms.

Fractures of the cervical spine occur most often between the third and sixth vertebrae and are often the result of direct violence due to a fall, such as diving in shallow water. In such injuries manipulation should be carefully approached, as it may only serve to increase the severity of the condition, and the objective clinical symptoms should be depended upon for a diagnosis.

Although the physician should do no manipulating in making his diagnosis, the roentgen ray helps in differentiating between cervical fracture with and without displacement. Both anteroposterior and



FIG. 235. Compression fracture of body of 6th cervical with cord symptoms, showing importance of lateral view of cervical spine in preference to an anteroposterior view for purpose of showing compression fractures.

lateral views as well as clear detail are absolutely essential. The lateral view shows the body of the vertebra more distinctly than the anteroposterior view, and so is the more valuable in the diagnosis of compression fracture which usually occurs in the body of the vertebra. During the early stages of treatment, roentgenograms taken every two or three weeks will show whether any such complication as Kümmell's disease (rarefying osteitis of the vertebra) is establishing itself (see Figs. 248 to 251).

SPINAL INJURIES

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SYMPTOMS. In cases showing cord symptoms and also in those without cord symptoms there are localized pain, rigidity, loss of motion, muscle spasm and sometimes distortion. In fractures with

FRACTURE RECORD					
Name	P.G.	Address	7223 S. WOOD STREET	Case No.	104
Age	22	Sex	M.	Date	
Occupation	LABORER			Dr.	FORRESTER
Cause of Fracture	FELL FROM A SCAFFOLD				
X-Ray No.	29080				
EXAMINATION			TREATMENT	RESULT	
Bone	GTH CERVICAL VERTEBRA	Closed Reduction		Good	Moderate
Site	NECK	Method and Position of Fixation	TRACTION WITH HEAD	Bad	
Type	COMPRESSED	HALTER AND COUNTER EXTENSION			
Simple	Transverse	Anesthetic Used	Yes		
Comminuted	Oblong	Anatomical Result obtained	COUD		
Into Joint	Spiral				
Subperiosteal	Impacted				
Grooved	Comminuted	Other Prostheses	CONVALESCENT SPLINT		
COMPRESSED			Method and Position of Fixation		
Description of Deformity including shortening			LEATHER EXTENSION COLLAR.		
NO OBJECTIVE DEFORMITY.					
Nature and Extent of Injury to Soft Parts especially nerves and vessels			Anatomical Result obtained		
ECCHYMOSIS, EDGES, AND ABRASIONS TO BACK AND NECK.					
TEMPORARY PARALYSIS BELOW LESION.					
RAPID RECOVERY SAVE LEFT ARM REGION.					
X-Ray					
Before Reduction COMPRESSION GTH CERVICAL.			When	Mortality	
After Reduction SAME			Period of Complete Immobilization	Date	
At Discharge COMPLETE HEALING			6 WEEKS	Main cause of death	
Haussermann Test NEGATIVE			Period of Protection	Absence from work: Duration	
			6 MONTHS	16 MONTHS	
			Total Period of Protective Treatment	Ability to resume job	
			1 YEAR	LICHT WORK	
				Present Wage earning capacity	
				DECREASED	
				Compensation obtained: Yes?	
				Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 194 A.C.S. Case Record System
Formerly Case Record Circular

FIG. 236. Fracture record of case shown in Figure 235.

cord symptoms, there is sometimes immediate paralysis, varying in extent depending on the extent of cord injury, and sometimes temporary unconsciousness, followed by a paralysis more or less complete. If the cord has been entirely severed, the epidermic and protopathic tests show that the line below which there is no sensation extends directly across the body. If the cord is only partially severed or being pressed upon, this line is variable in direction, that is, high on one side of the body and low on the other. If hematomyelia and not severance of the cord causes the paralysis, the line below which there is loss of sensation may, immediately after injury, extend either directly across the body or else in a variable direction. In cases with hematomyelia, however, within a few days of injury,

sensation may begin to return by slow degrees, whereas in cases of complete or partial cord severance the return of sensation is long delayed, if it returns at all. Where the cord is completely severed



FIG. 237.

FIG. 237. Anteroposterior view showing possible fracture through body of 5th cervical vertebra with no cord symptoms.



FIG. 238.

FIG. 238. Lateral view of same case as Figure 237, much easier of diagnosis.

there will be no improvement. Pressure on the cord likewise is characterized by varying degrees of loss of sensation, depending on the intensity of pressure. Loss of sensation due to pressure will of course clear up only if the pressure can be relieved. Occasionally in a high lesion, i.e., between the second and third cervical, the temperature jumps rapidly within twenty-four hours and keeps going up. One can safely prognose death because of involvement of the heat centers.

TREATMENT. *Fractures with no spinal cord symptoms*, whether or not they are compression fractures, heal satisfactorily if properly

supported by a brace for a year to eighteen months, depending upon the severity of the fracture. During the greater part of the period of treatment most patients can perform various tasks. If directly after injury the patient suffers considerably from pain, rigidity and muscle spasm, a counterextension with halter and weights should be applied for a month or six weeks, after which a cast can be molded to the shoulders and head, or a collar made from a plaster mold. A mechanical collar (Fig. 242) is by far the most practical type of appliance, because by turning the nuts on the threaded bars the entire head can be raised and adjusted in any direction, thus removing weight from the injured vertebra.

Fractures with spinal cord symptoms presuppose long and tedious treatment. In the cases which show pressure on the cord the question as to whether operation should be performed is a debatable one. Personally, I am opposed to surgical interference in fracture of the cervical spine, as the cases with which I am acquainted show 100 per cent mortality. I believe that conservative treatment consisting of the immediate application of a head halter, with Buck's extension and a weight of at least 5 lbs. applied to each leg (Fig. 246) can accomplish more than any surgical procedure. A pull of 5 lbs. should be exerted on the head halter; however, in some patients this weight must be slightly relieved at intervals. This method of countertraction must be continued for one and one-half to two months. It gives almost immediate relief in many cases, particularly those of fracture with hematomyelia. The collar shown in Figure 242 can then be used.

The treatment of a case with a severed or partially severed spinal cord is the same as that of a case with cord compression, although in the former death is the almost inevitable outcome. If a fracture low down (lower dorsal or lumbar) with spinal cord lesion produces paralysis of only the extremities, the treatment is the same as that used in fracture of a dorsolumbar segment (p. 174).

In spite of my poor opinion of surgical measures, I realize that occasionally other surgeons have been successful in operations for cervical fracture. If, after a few weeks of the more conservative non-operative treatment, a surgeon wishes to operate on what seems a hopeless case of fracture with a cord compression, he may attempt a decompression operation. The best time for operation, providing



FIG. 239.



FIG. 240.

Figs. 239 and 240. Cervical splint with angulated fracture of body of 6th cervical vertebra and collapse of anterior portion, showing value of securing both anteroposterior and lateral views. No cord pressure symptoms but some neck pain and stiffness. The skull fracture was so severe that neck condition was entirely overlooked until, while coming to office for after-treatment, patient complained of neck. Roentgenograms revealed this condition. It gradually improved and he recovered entirely.

Case demonstrates that such a fracture should be looked for wherever a patient has fallen on his head, as it can occur with absolutely no focal symptoms. Importance of surgeon going over case carefully is evident.

SPINAL INJURIES

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the patient lives, would be a month or more after injury, when a suitable bony support will have developed. This, together with the collar, as Taylor braces cannot be used in cervical fractures, will

FRACTURE RECORD						
Name W.J.C.	Address 2128 N. KEDZIE AVENUE	Case No. 74287 Date 12-8-27M. Dr. FORRESTER				
Age 43	Sex M	M. & W. D.	White or Colored	Time of Occurrence of Accident 9-30-26		
Occupation STRUCTURAL IRON WORK			Hospital Entered ALEXIAN BROTHERS			
Cause of Fracture FELL TWO FLOORS THROUGH ELEVATOR SHAFT, STRIKING HEAD.			First Treatment			
			Final Reduction			
EXAMINATION		TREATMENT		RESULT		
Bone SKULL	Closed Reduction	Anatomical	X	Good	Moderate	
Site LEFT PARIETAL BONE	Method and Posture of Fracture	Functional	X	Moderate	Bad	
Type DEPRESSED SKULL FRACTURE		Description of End Result, including Disability, Shortening, Function, Pains, Swelling, Nerve (a) At discharge from Hospital: Date				
Simple	Transverse	Anesthetic Used	Yes	No		
Compressed	Oblique	COMPLAINED OF HEADACHE AND DIZZINESS.				
Two Joint	Spiral	PAIN IN BACK OF NECK.				
Synostosed	Impacted					
Greenstick	Comminuted	Open Reduction				
		Method and Posture of Fixation				
Description of Deformity including shortening		TREPANNING OF SKULL, REMOVAL OF FRAGMENTS AND BLOOD CLUT.	(b) At discharge from O. P. D.: Date			
		ALL SUBJECTIVE				
		Anatomical Result obtained				
Nature and Extent of Injury to Soft Parts			(c) At subsequent date: Date			
especially nerves and vessels			Disability: None Partial			
LACERATION OF SCALP OVER LEFT PARIETAL REGION.		Was non-operative treatment used first?	COMPLETE FIVE MONTHS AND PARTIAL SINCE			
		How long after injury was operation performed? 2 HOURS				
		Was internal fixation material subsequently removed?				
X-Ray		Why	Mortality Date			
Before Reduction		When	Main cause of death			
After Reduction		Period of Complete Immobilization	Absence from work: Durations			
At Discharge		Period of Protection	*Ability to resume job			
Wassermann Test NEGATIVE		Total Period of Protective Treatment	*Present Wage earning capacity			
			Compensation obtained: Yes? No?			
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion						

Form 19 A.C.S. Case Record System
Patient Name: **W.J.C.**

FIG. 241. Fracture record of case shown in Figures 239 and 240.

assist in maintaining continuity. In such an operation the surgeon must be very sure of his technique,* and asepsis is essential. A plaster shell or a steel brace should be ready for application immediately after operation. A plaster shell is superior to a steel brace, as a window can be made particularly for dressing purposes. Should the patient live, the steel brace must be worn for a year and a half to two years. Entire recovery from the paralysis hardly ever occurs.

Fracture of the cervical neck with spinal cord symptoms involves serious problems as to the nursing of the patient, and these, in conjunction with possible complications closely associated with the

* Frazier, C. H. *Surgery of the Spine and Spinal Cord*. Appleton, N. Y., 1918.

fracture itself, make for a high mortality. Sphincter troubles and bedsores are especially annoying. Enemas must be given and catheterization employed. Some physicians permit the bladder to empty

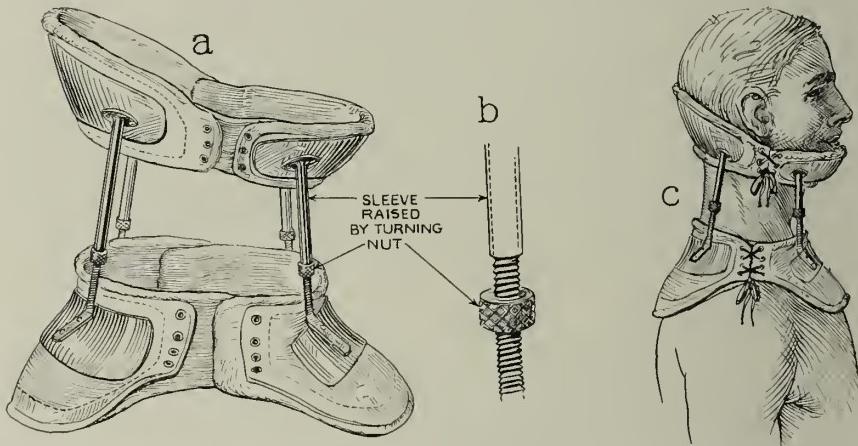


FIG. 242.



FIG. 243.



FIG. 244.

Figs. 242-244. Extension collar for injuries to the cervical spine. (See Figs. 247 and 248.)

by overflow, but this method is both painful and dangerous. Catheterization is, of course, dangerous, but if performed as carefully as is a major operation, infection can be kept well under control. A retained catheter may prove more beneficial. In the case of bladder infection, potassium permanganate or argyrol or a weak solution of silver nitrate may be used for irrigations. Massage of the body with alcohol will help delay the formation of the inevitable bedsores; a

combination of one-half cocoa butter and one-half cream mixed together is the most efficacious preventative.

PROGNOSIS. The disability period, if the patient lives, naturally varies widely, depending upon the extent of the fracture and the degree of cord involvement. *In cases of fracture without spinal cord involvement*, the disability will last from nine to eighteen months. In many of these cases where paralysis does not exist some kinds of occupation can be followed after the collar has been worn for three months.

In cases of fracture showing spinal cord involvement, death is practically certain if the line below which there is no sensation extends directly across the body. In the cases which survive with lower lesions disability lasts for a period of one and one-half to two years and the patient is likely to be left with a well-defined paralysis of varying degree depending on the severity of the initial injury. The return of motor function in the anterior tibial nerves is always doubtful, and in many cases a drop-foot shoe must be worn, sometimes indefinitely (see Fig. 586).

Even if the physician feels sure of the patient's ultimate recovery from the fracture itself, he must always guard most carefully his estimation as to the length of the disability period because of the various complications that are almost sure to develop in spite of expert medical and nursing care.

HEMATOMYELIA OF THE CERVICAL SPINE

SYMPTOMS. The symptoms of hematomyelia include pain and tenderness at the site of the injury, with spasm and an extensive number of varied disassociated paralyses and sensory symptoms which occur within a short time after injury, but which tend gradually to disappear after the first few days of treatment.

Sometimes the onset is gradual, manifested by a growing weakness of one or more extremities followed by paralysis. There is little or no pain in the extremities, but at first there will be flaccidity and numbness followed by a pricking sensation and gradually increasing ability to move the body, usually first noticeable in upper extremities. The negative findings of the roentgenogram in regard to fracture help to confirm the diagnosis.

TREATMENT. The patient should be put to bed at once and a head halter immediately applied, with Buck's extension, and counterextension of the extremities. The head halter immediately relieves the pain at the site of injury. The patient should be very carefully nursed, close attention being paid to the general bodily functions. Within ten days notable improvement should occur as to return of sensation and bodily control. After four or six weeks the head halter may be removed and a collar (Fig. 242) put on, and counterextension continued.

Two or three and sometimes four months elapse after injury before the patient can move about in bed to any extent. He may then be placed in Fowler's position in bed or in a wheel chair and later may be allowed to walk with the help of crutches or a walking chair. Gentle massage is necessary during the entire period of treatment, combined with the application of a slow sinusoidal galvanic current, beginning with 50 or 60 ma., in order to keep the muscles in good condition. This treatment should be applied to affected muscle groups for about fifteen minutes over each. As recovery develops the patient must have as much exercise as possible without over-exertion or producing muscle fatigue, whether in Fowler's position in bed, in a wheel chair, or on crutches.

PROGNOSIS. The disability period lasts nine months to a year and usually is followed by complete recovery if care is taken during this period to keep up the muscle tone.

COMPLETE OR PARTIAL DISLOCATION OF THE CERVICAL SPINE

SYMPTOMS. This rare condition, which seldom occurs without an accompanying fracture, is usually marked by a forward or lateral displacement of the head. The chin points toward the chest and there is definite kyphosis and usually rotation of the head toward one side or the other, depending on the side affected by the dislocation. Almost always there are complete paralysis with definite localized pain, and rigidity and muscle spasm. A stereoscopic lateral roentgenogram is an excellent aid in making the diagnosis.

TREATMENT. Immediate, light and careful manipulation is necessary in reducing the dislocation. The surgeon not only must have a thorough knowledge of osteology but he must use common sense in determining the degree of manipulation necessary to reduc-

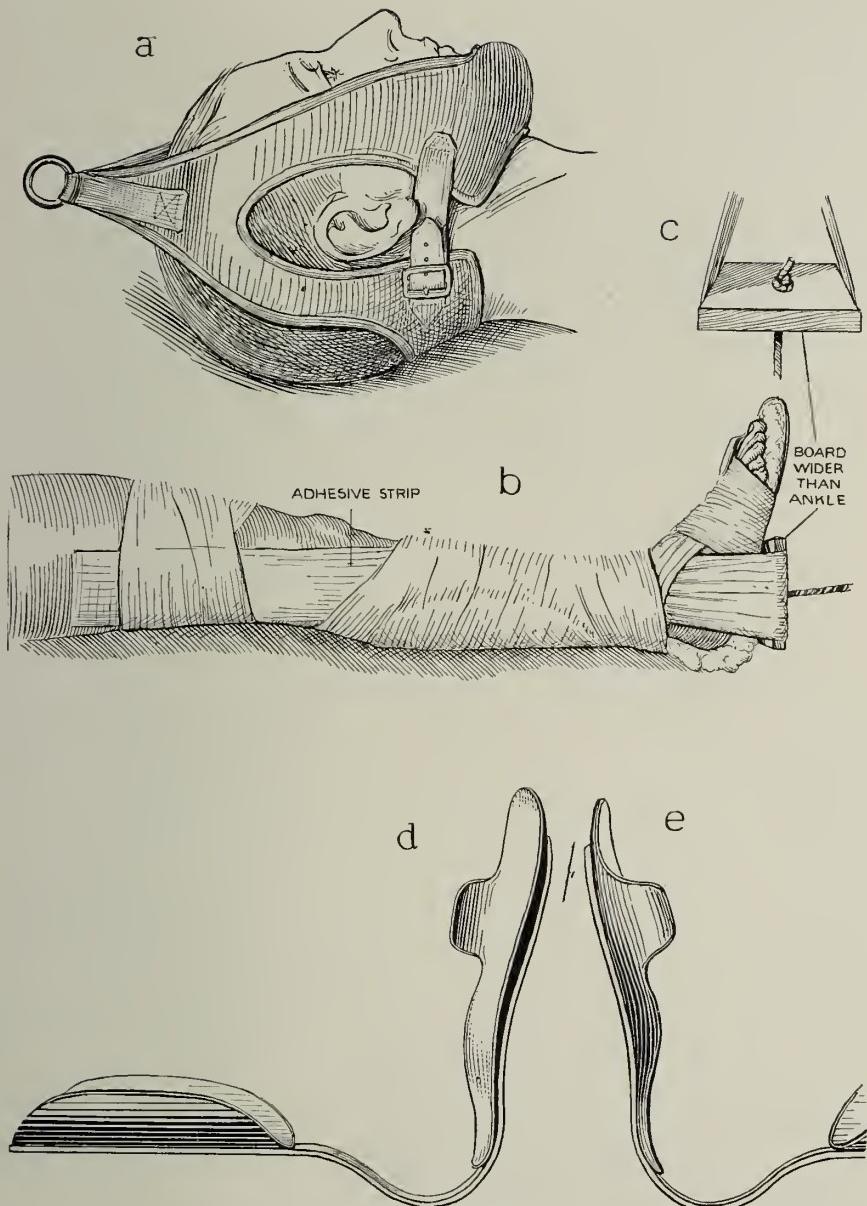


FIG. 245. a. Method of applying head halter and counterextension for fracture of spine. b, c, d and e. Club-foot shoes to maintain position of feet and avoid foot-drop and pressure necrosis of heels in early treatment of any spine fracture and particularly where paralysis exists.

tion but harmless so far as permanent injury to the spinal cord is concerned. Manipulation may be done with the patient's head extending over the end of the table. The surgeon should exert a

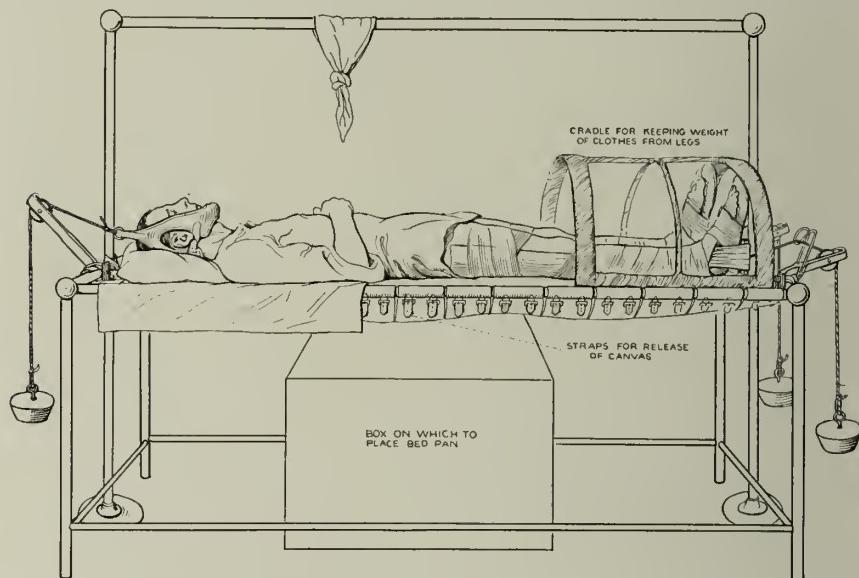


FIG. 246. Fracture bed with counterextension and hyperextension of spine. Weights of 5 lbs. each.

steady pull on a line with the long axis of the spine, avoiding undue rotation, hyperflexion or hyperextension. Some pressure may be applied to the spinous processes below the injury.

PROGNOSIS. The disability period, should the patient live, must be estimated with great caution, since this rare injury is usually associated with fracture, and since the necessary manipulation or original injury may do permanent damage to the cord. The cases of partial dislocation are, as a rule, more favorable as to outcome than those of total dislocation. Disability lasts from nine months to a year and longer in cord involvement, providing the patient lives. The mortality rate is high.

FRACTURES OF THE DORSAL AND DORSOLUMBAR SPINE

This injury is uncommon compared with the number of fractures of the lumbar spine. It usually occurs in the first 5 or in the 10th,



FIG. 247.



FIG. 248.

Figs. 247 and 248. Partial forward dislocation of 2nd cervical with slight cord symptoms lasting approximately seventy-two hours. Application of head halter clearing it up.

FRACTURE RECORD

Name <u>S.C.</u>	Address <u>KNOXVILLE, ILL.</u>	Date <u>81958</u>								
Age <u>49</u>	Sex <u>M.F.</u>	Mr. S. W. D.	White or Colored	Time of Occurrence of Accident <u>7-8-27</u>						
Occupation <u>LABORER</u>				Hospital Entered <u>GALESBURG COTTAGE</u>						
Cause of Fracture <u>STRUCK ON HEAD BY HEAVY SCOOP OF CONCRETE MIXER</u>				First Treatment						
				Final Reduction						
				RESULT						
				<table border="1"><tr><td>Good</td><td>Moderate</td><td>Bad</td></tr><tr><td>X</td><td></td><td></td></tr></table>	Good	Moderate	Bad	X		
Good	Moderate	Bad								
X										
				Description of End Result, including Deformity, Shortening, Function, Pain, Sensitza., Nerve (a) At discharge from Hospital: Date <u>1-27-28</u>						
				WEARING EXTENSION COLLAR. GETTING ABOUT WALKING NORMALLY.						
				(b) At discharge from O. P. D.: Date <u>1-27-28</u> . NO EVIDENCE CORD DAMAGE. ROTARY LIMIT NECK MOTION. OCCASIONAL PAIN IN NECK.						
				(c) At subsequent date: Date Disability: <u>None-Painless Gait</u> TOTAL 8 MONTHS						
				Mortality Date Main cause of death						
				Absence from work: Duration APPROX. 9 MONTHS. *Ability to resume job						
				*Present Wage earning capacity						
				Compensation obtained: Yes? No?						
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion						

Form 15-5-C-8 Case Record System
Southern Company, Chicago

FIG. 249. Fracture record of case shown in Figures 247 and 248.

11th or 12th dorsal vertebrae and when in the lower dorsal usually in conjunction with a fracture involving the 1st and 2nd lumbar vertebrae. Fractures of the dorsal and lumbar spine are as a rule



FIG. 250.

FIG. 250. Referred case of typical Kümmell's disease. At first lateral view of spine not made, hence failure to diagnose condition.

FIG. 251. Lateral view of same case, showing definite compression of body of 12th dorsal vertebra with no opportunity to preserve intervertebral spaces by early extension.



FIG. 251.

compression fractures of the bodies of the vertebrae. The injury is the result of a fall, landing in a sitting position, or a sudden bending forward (*jack-knifing*).

SYMPTOMS. The symptoms often include sudden pain in the injured part of the back, muscle spasm, rigidity and inability to move. Paralysis, either partial or complete, is absent unless the spinal cord is involved (see p. 180 for description of the paralysis charac-



FIG. 252. Same case as Figures 250 and 251.

FRACTURE RECORD

Case No. 78958

Date _____ - Hr. _____

Dr. FORRESTER

Name	MISS P.T.		Address											
Age	35	Sex	M. F.	M. S. W. D. --	White or Colored	Time: Occurrence of Accident								
Occupation					6-26-26									
Cause of Fracture	IN AUTOMOBILE ACCIDENT. THROWN OUT OF CAR.				Hospital Entered	3-31-27								
					First Treatment									
					X-Ray No.	Final Reduction								
EXAMINATION			TREATMENT			RESULT								
Bones 12TH THORACIC - KÜMMEL'S DISEASE.			Closed Reduction			<table border="1"> <tr> <td>Anatomical</td> <td>Good</td> <td>Moderate</td> <td>Bad</td> </tr> <tr> <td>Functional</td> <td></td> <td></td> <td></td> </tr> </table>	Anatomical	Good	Moderate	Bad	Functional			
Anatomical	Good	Moderate	Bad											
Functional														
Site BACK			Method and Position of Fixation			Description of End Results, including Deformity, Shortening, Function, Pain, Swelling, Nerve								
Type:	Simple	Transverse	Anesthetic Used	Yes	No	(a) At discharge from Hospital: Date 4-21-27								
	Compound	Oblique	Anatomical Result obtained			PAIN ALONG BACK AT LEVEL OF 11TH AND								
	Intra-articular	Spiral				12 THORACIC VERTEBRAE. GIVEN TAYLOR								
	Subperiosteal	Impacted X				SPINE BRACE TO WEAR FOR SIX MONTHS.								
	Grooved	Comminuted	Open Reduction											
	Method and Position of Fixation			(b) At discharge from O. P. D.: Date										
Description of Deformity (including shortening)														
WARPING OF BODY OF 12TH														
Nature and Extent of Injury to Soft Parts especially nerves and vessels						(c) At subsequent date: Date								
TOES			Was non-operative treatment tried first?			Disability: Absent, Partial, Complete								
			How long after injury was operation performed?											
			Was internal fixation material subsequently removed?											
X-Ray T28			Why			Mortality								
Before Reduction NO REDUCTION			When			Date								
After Reduction			Period of Complete Immobilization			Main cause of death								
At Discharge			Period of Protection: APPARENTLY NO FIXATION OF SPINE AND PARTIAL PROTECTION THREE MONTHS Post-Operative Protection			Absence from work: Duration								
Wassermann Test			IN THE AFTER PERIOD.			*Ability to resume job								
						*Present Wage earning capacity								
						Compensation obtained: Yes? No?								
						*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion								

Form 194 A.C.S. Case Record System
Futura Company, Chicago

FIG. 253. Fracture record of case shown in Figures 250-252.

teristic of spinal fractures with cord lesions). Following the diagnosis the head-halter traction should be used with the patient lying in the position of hyperextension until a suitable brace can be obtained, and this should be worn for at least nine months to a year. The easiest way to produce hyperextension in the early stages of treatment is to place one or two pillows under the small of the back transverse to the long axis of the body. This is particularly useful when the patient is lying in a sagging bed, and when the mattress sags planks placed transversely under the spring will help materially. Should the cord be involved the patient will be treated as in other lesions. There are cases, however, characterized by a slight backache and a slight degree of discomfort and inability to get about. If the condition is not diagnosed promptly, the patient may continue with his work until a definite deformity takes place. This is usually in the form of a kyphosis, and develops into Kümmell's disease (see Figs. 250 to 253).

THE ROENTGENOGRAM IN DIAGNOSIS. The roentgenogram is highly important in the early diagnosis of this condition, since the slight symptomatology alone deceives the physician as to the presence of a serious lesion. Roentgenograms should be taken from both anteroposterior and lateral views. A clear lateral roentgenogram showing fracture of the bodies of the 1st to the 5th dorsal vertebra is difficult to obtain but can easily be taken below the 5th. Special attention should, then, be paid to the making and interpretation of the films of the upper dorsal region.

TREATMENT. *Fractures without Spinal Cord Involvement.* The patient is put to bed, the spine hyperextended, and a head halter and counterweight applied (Fig. 246). Hyperextension of the spine can be obtained by placing planks or table leaves under the mattress from one side of the bed to the other and one or two pillows under the small of the back. This method of treatment should be followed for six to eight weeks and then the spine immobilized by the application of a Taylor spine brace. If this brace is not obtainable some modification of it may be used, or the patient may be placed in the position of hyperextension by means of a Bradford frame or a jury-mast, and a plaster shell then placed about the body from the hips to the axilla. Knowles of Iowa has devised a very satisfactory table for applying a plaster shell to such cases. Plenty of pads should be placed

over the crest of the ilium and along the curve of the spine and sacrum to avoid pressure necrosis.

This cast or the Taylor spine brace should be worn for at least



FIG. 254.



FIG. 255.

FIGS. 254 and 255. Compression fracture showing healing and nature's bridging by bone growth between bodies of vertebrae.

nine months to a year, for, if removed too soon, the body of the involved vertebra collapses, causing kyphosis and continuous pain. If, in spite of the pads, the cast causes too much irritation, it should be removed and a fresh one applied. If worn for the proper length of time, either of these devices permits the development of callus and a compensatory hypertrophy of the intercartilaginous discs.

If the surgeon wishes to send to an orthopedic house appliance for a Taylor spine brace, he should take the following measurements for the makers of the brace:

1. The distance from the upper border of the scapula to the hollow of the sacrum.
2. The circumference around the axilla.
3. The circumference around the abdomen.
4. The circumference around the hip just below the crest of the ilium and just above the head of the femur.

The surgeon should also take a piece of malleable metal, place it against the spine and mold it to the curves from the upper border of the scapula to the hollow of the sacrum, lay the metal on a piece of paper and draw the outline. This outline should be sent to the maker of the brace along with the patient's measurements.

Roentgenograms to determine the rate of healing should be taken at least every three months. In these films the surgeon will notice, that, in addition to the change in the intervertebral discs and a hardening of the body of the vertebra, there will occasionally develop a bony ridge from the anterior or ventral surface of the body of the involved vertebra to the ones below and above it.

Fractures with Spinal Cord Involvement. These cases, like those without spinal cord involvement, should first be treated by the application of a head halter with counterextension, and hyperextension of the spine (see Fig. 246). This form of treatment must be continued for two months or more. As soon as the patient is able to move to some extent, where the paralysis is not severe, a Taylor spine brace should be applied, in preference to a heavy plaster shell. In such a case the brace should not be removed until (1) the roentgenograms show the formation of a substantial amount of callus and (2) upon pressure with the fingers over the affected area, tenderness has practically disappeared.*

The careful application of a sinusoidal galvanic current to the muscles below the seat of the lesion helps keep them in a satisfactory state of tonicity. If the sphincters are involved, one pole placed over the sacrum and one over the symphysis assist in re-establishing sphincter control. All bodily functions must be carefully watched (catheterization will be necessary) and bedsores should be treated very thoroughly in order to avoid septic absorption as far as possible.

The case with spinal cord involvement is likely to be left with a varying degree of paralysis, either of the sphincters or of the extremities. Paralysis of the extremities usually leaves permanent effects on the anterior tibial group of muscles. The wearing of a club-foot shoe (see Fig. 245) during treatment keeps the patient's heel off the bed by means of a curved piece of metal under the heel, thus preventing pressure necrosis. It also holds the foot at right angles and

* When the paralysis is severe with loss of the use of both sphincters and extremities it becomes a long-drawn-out case in bed with quite a delay before a brace can be applied.



FIG. 256.



FIG. 257.

Figs. 256 and 257. End-result compressed fracture of the spine showing healing by bony bridge after wearing of Taylor spine brace.

FRACTURE RECORD					
Name	A.D.	Address	JOLIET, ILLINOIS		
Age	Sex	M.	M. S. WEBB	White or Colored	Case No. 75081
Occupation	LABORER			Time: Occurrence of Accident	10-26-26
Cause of Fracture	LARGE DIPPER OF A CONCRETE HOPPER DROPPED ON HIM JERKING HIM FORWARD IN A JACK KNIFE POSITION.			Hospital Entered	SILVER CROSS
				First Treatment	10-27-26
				X-Ray No.	35825
				Final Reduction	SAME
EXAMINATION		TREATMENT		RESULT	
Bone	SPINE	Closed Reduction	TRACTION ON BOTH EXTREMITIES	Good	Moderate
Site	FIRST LUMBAR	Method and Position of Fixation AND COUNTER TRACTION ON HEAD AND BACK IN HYPEREXTENSION		Functional	Bad
Type:		Anesthetic Used	Yes	X	
		Anatomical Result obtained FAIR		Description of End Result, including Deformity, Shortening, Function, Pain, Sensing, Nerve	
				(a) At discharge from Hospital Date 4-22-27	
				FOOT DROP (R) STILL PRESENT. OBJECTIVE BACK DEFORMITY. X-RAY SHOWS HEALED 1ST	
				OF BACK. WEARING TAYLOR SPINE BRACE.	
		Open Reduction			
		Method and Position of Fixation			
				(b) At discharge from O.P.D. Date 1-12-28	
				FOOT DROP (R) STILL PRESENT. OBJECTIVE BACK DEFORMITY. X-RAY SHOWS HEALED 1ST	
				LUMBAR FRACTURE. SLOW RETURN OF RIGHT LOWER LEG.	
Description of Deformity (including shortening)					
LATERAL DISLOCATION OF THE SPINE FROM IMPACTION, DOWNWARD.					
Anatomical Result obtained					
(c) At subsequent date Date					
Nature and Extent of Injury to Soft Parts <i>(nervous tissue and vessels)</i>					
RETENTION OF URINARY AND RECTAL SPHINCTERS: Was non-operative treatment tried first? YES					
LOSS OF FUNCTION IN BOTH LOWER EXTREMITIES: How long after injury was operation performed? NONE					
LOSS OF REFLEXES: Was internal fixation material subsequently removed?					
X-Ray BADLY IMPACTED Why? Mortality NO Date					
Before Reduction BADLY IMPACTED When Main cause of death					
After Reduction IMPROVED Period of Complete Immobilization Absence from work: Duration PROBABLY 14 YEARS					
At Discharge GOOD CONSIDERING BAD IMPACTION. Period of Protection 1 YEAR *Ability to resume job UNKNOWN					
Wassermann Test Total Period of Protective Treatment *Present Wage earning capacity					
Compensation obtained: Yes? No?					
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion					

Form 19/A.C.S. Case Record System
Parham Company, Chicago

FIG. 258. Fracture record of case shown in Figures 256 and 257.

so avoids plantar extension of the foot, which is caused by the strong posterior group of muscles pulling the heel up and the toes down. Should fibrosis of the ankle joint develop in a patient whose

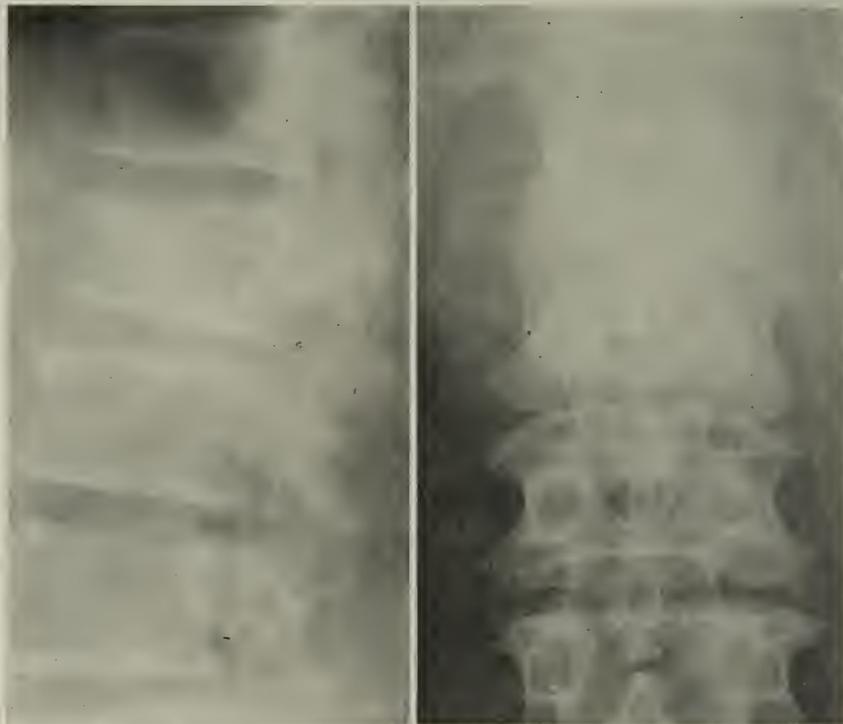


FIG. 259.

FIG. 260.

FIGS. 259 and 260. Compression fracture of 1st lumbar vertebra. Importance of lateral view is demonstrated by the fact that anteroposterior view does not define fracture.

foot is not supported by a club-foot shoe, tenotomy of the Achilles tendon, with wrenching of the foot and the application of a cast, is often necessary before the foot can be got back into the position of election for walking. Such surgical procedures are avoided if the club-foot shoe is worn during treatment by patients with evidence of paralysis of the anterior tibial muscles. When treatment is finished a drop-foot shoe (see Fig. 586) can be worn. This shoe has a metal arch plate inside, with a check at the ankle joint and a side-iron that extends up the leg to the calf, the check at the ankle preventing a dropping of the foot.

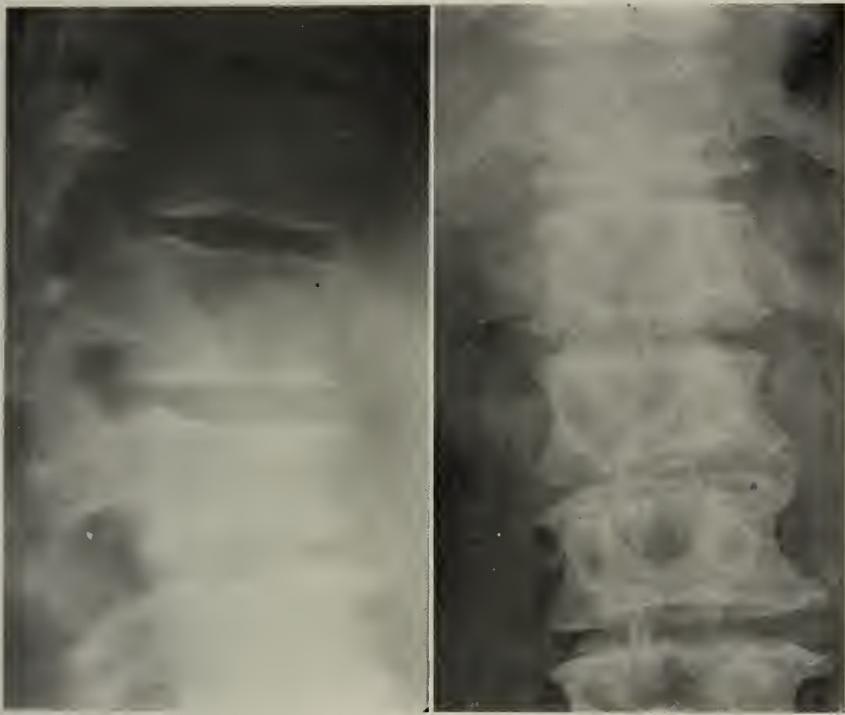


FIG. 261.

FIG. 262.

FIG. 261. Lateral view of same case seven months after accident, showing normal curve of spine maintained and intervertebral spaces preserved. (See chart, Fig. 263.)

FIG. 262. Anteroposterior view taken seven months after accident, showing slight reduction of body of 1st lumbar vertebra of body.

FRACTURE RECORD									
Name	J. E.		Address	5121 THIRTY SECOND STREET, CICERO			Case No.	21-62	
Age	56	Sex	M	M	White or Colored		Date		
Occupation	GATE MAN						Hospital Entered	ST. ANTHONY	
Cause of Fracture	WAS CLOSING GATE. GATE FELL ON HIM.								
							First Treatment		
							Final Reduction		
EXAMINATION				TREATMENT			RESULT		
Bone	SPINE			Closed Reduction			Good	Moderate	Bad
Site	FIRST LUMBAR VERTEBRA			Method and Position of Fixation			TAYLOR SPINE		
Type	COMPRESSION			BRACE					
	Simple	Transverse		Anesthetic Used	Yes	No			
	Compound	Oblique		Anatomical Result obtained			SLIGHT WEDGING OF		
	Int. Joint	Sacro		FIRST LUMBAR VERTEBRA					
	Schisis	Intraarticular		Open Reduction					
	Osteoma	Consolidated		Method and Position of Fixation					
Description of Deformity (including shortening)									
SLIGHT WEDGING OF FIRST LUMBAR							(a) At discharge from Hospital - Date		
VERTEBRA							NO SPASM BACK MUSCLES		
							NO DISTURBANCE GAIT		
Nature and Extent of Injury to Soft Parts excluding nerves and vessels									
CONTUSIONS AND ABRASIONS				Was non-operative treatment used first?			Disability: Absent, Partial, Complete 20% DISABILITY		
				How long after injury was operation performed?					
				Was internal fixation material subsequently removed?					
X-Ray				Why			Mortality Date		
Before Reduction				When			Main cause of death		
After Reduction				Period of Counterimmobilization			Absence from work: Duration		
At Discharge				Period of Protection			Ability to resume job		
Wassermann Test				Total Period of Protective Treatment			Present Wage earning capacity		
							Compensation obtained: Yes? No?		
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion									

Form 19-A.C.B. Case Record Sheet

FIG. 263. Fracture record of case shown in Figures 259-262.

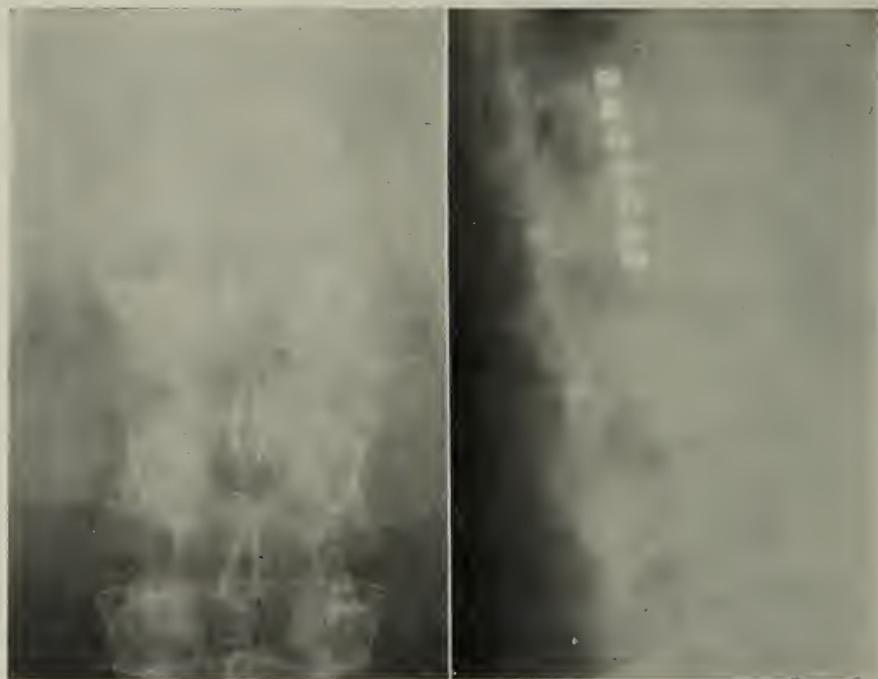


FIG. 264.

FIG. 264. Anteroposterior view showing impaction of the body of the 2nd lumbar vertebra on the right side.

FIG. 265.

FIG. 265. Lateral view taken at same time showing compression of the body.



FIG. 266.

FIG. 266. Lateral view taken one year later, showing compression of body with apparent compensatory thickening of intervertebral cartilage.

FIG. 267.

FIG. 267. Anteroposterior view taken one year later, showing bone proliferation on right side between bodies of 1st and 2nd lumbar vertebrae, nature's method of building support.

SPINAL INJURIES

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The question of surgical interference in cases of fracture of the dorsal spine is considered on page 174.

PROGNOSIS. In cases without spinal cord involvement, the dis-

FRACTURE RECORD					
Name	T.R.	Address 5955 LELAND AVENUE		Case No. 58615	
Age 45	Sex M	M. Satisfied	White or Colored	Date 4-8-25	Mr.
Occupation STRUCTURAL IRON WORKER					Dr. FORRESTER
Cause of Fracture A CONCRETE FORM FELL FROM ABOVE AND STRUCK HIM ABOUT BACK					
X-Ray No. 23332					
EXAMINATION		TREATMENT		RESULT	
Bone SPINE		Closed Reduction YES	Method and Position of Fixation EXTENSION TO SPINE	Good	Moderate
Site SECOND LUMBAR VERTebra		Anesthetic Used Yes	Anatomical Result obtained	X	
Type IMPACTED				X	
Simple	Transverse			Description of End Results including Disability, Shortening, Function, Pain, Swelling, Nerve	
Compound	Oblique			(a) At discharge from Hospital Date 4-26-25	
Intra-articular	Spiral			WEARING TAYLOR SPINE BRACE	
Subarticular	X Impacted			(b) At discharge from O.P.D. Date 5-21-25	
Groenwick	Consolidated		Open Reduction	RESTRICTED MOTION OF SPINE ABOUT SITE OF FRACTURE	
Description of Deformity including shortening					
SLIGHT WEDGING OF SECOND LUMBAR VERTebra					
Nature and Extent of Injury to Soft Parts especially nerves and vessels					
CONTUSION OF TISSUES					
Was non-operative treatment tried first?					
How long after injury was operation performed?					
Was internal fixation material subsequently removed?					
X-Ray					
Why					
Before Reduction		When	Mortality Date		
After Reduction			Main cause of death		
At Discharge	BONY UNION WITH CALLUS	Period of Complete Immobilization 20 DAYS	Absence from work: Duration		
Wassermann Test	NEGATIVE	Period of Protection 8 MONTHS	Ability to resume job		
Total Period of Protective Treatment 8 MONTHS					
AND 20 DAYS					
*Present Wage earning capacity					
Compensation obtained: Yes? No?					
*Black Ink: Surgeon's Options Red Ink: Patient's Options					

Form 19-A.C.E. Case Record System
Futura Form Company, Chicago

FIG. 268. Fracture record of case shown in Figures 264-267.

ability period extends over nine months to a year, depending upon the amount of bone destruction, the brace or cast being worn for nine months to a year of this period. In cases of spinal cord involvement, the disability period is indefinite, since as a rule the patient is left with some degree of muscular atrophy which prevents the muscles regaining their natural tone. He is also likely to suffer to a varying degree from lack of sphincter control and perhaps from partial or permanent paralysis of the extremities. This paralysis usually affects the anterior tibial group of muscles and calls for the wearing of a club-foot and then a drop-foot shoe. The disability period may also be greatly lengthened by the absorption of toxic

material from bedsores or from such infections as those of the kidney and bladder, since the patient's resistance and vitality are at a low ebb. In the latter type the mortality rate is high.



FIG. 269. Compression fracture of the 2nd lumbar vertebra treated by Taylor spine brace.

SURGICAL INTERFERENCE IN FRACTURES OF THE BODIES OF THE VERTEBRAE OF THE DORSOLUMBAR SPINE

In regard to the much debated question of surgical interference in fractures of the bodies of the vertebrae of the dorsolumbar spine, I am in favor of non-operative treatment of all cases for one to two months. Where there is a fracture without cord lesion there is absolutely no indication for surgical interference. When a cord lesion is present, however, it becomes a much discussed question, as some surgeons are in favor of operating immediately; whereas I have seen so many cases even with fairly severe cord lesions recover without surgical interference that I am inclined to leave them alone to some extent. There is no question but what some selected cases call



FIG. 270.



FIG. 271.

FIG. 270. Same case taken one year later, showing no change in position or alignment of vertebra.

FIG. 271. Showing excellent position in anteroposterior view.

				FRACTURE RECORD		Case No. 52949 Date 8-20-24 Hr. Dr. CORRESTER		
Name	W.S.H.		Address					
Age: 58	Sex: M	R	M. S. Vn-D.	White as Entered:	Time: Occurrence of Accident			
Occupation				Hospital Entered				
Cause of Fracture SCAFFOLD GAVE WAY AND MAN FELL TO GROUND				First Treatment				
				X-Ray No. 22125	Final Reduction			
EXAMINATION		TREATMENT		RESULT				
Bone SPINE		Closed Reduction		Anatomical	Good	Moderate	Bad	
Site SECOND LUMBAR VERTEBRA		Method and Position of Fixation EXTENSION ON		Functional				
Type:		BRADFORD FRAME.		Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve				
Simple	Transverse	Anesthetic Used	Yes No	(a) At discharge from Hospital: Date				
Compound	Obligate	Anatomical Result obtained						
Intra Joint	Spiral							
Subluxated	X Impacted							
Genuvalgus	Contracted	Open Reduction						
Method and Position of Fixation				(b) At discharge from O. P. D.: Date 4-9-26				
Description of Deformity involving spine				GOOD MOTION OF BACK AT SITE OF INJURY.				
COMPRESSION OF SECOND LUMBAR VERTEBRA				NO MUSCLE SPASMS, RESTRICTION OR APPARENT				
				INTERFERENCE WHATSOEVER.				
Anatomical Result obtained								
Nature and Extent of Injury to Soft Parts								
especially nerves and vessels								
Was non-operative treatment tried first?				(c) At reoperation date Date				
How long after injury was operation performed?				Ability: Absent, Partial, Complete				
Was internal fixation material subsequently removed?								
X-Ray	Why				Mortality	Date		
Before Reduction			When		Main cause of death			
After Reduction			Period of Complete Immobilization		Absence from work: Days			
All Discharge	CALLUS FORMATION		25 DAYS		Ability to resume job			
Wassermann Test	NEGATIVE		Period of Protection 13 MONTHS		*Present Wage earning capacity			
			Total Period of Protective Treatment		Compensation obtained: Yes? No?			
					*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion			

Form 19 A.C.S. Case Reward System
FBI - San Francisco, California

FIG. 272. Fracture record of case shown in Figures 269-271.



FIG. 273.



FIG. 274.

FIGS. 273 and 274. Compression fracture of 4th lumbar vertebra treated by Taylor spine brace, showing excellent bony bridge laid down to splint spine.



FIG. 275. Same case as Figures 273 and 274, taken six months later, showing bony bridge.

for surgical interference. It is very difficult, however, to judge, and one is apt to become overconservative or too radical. Nature should be given a chance to do her own healing for a reasonable period of

FRACTURE RECORD					
Name	I. W.	Address	Case No.	61829	
Age	55	Sex	M. <input checked="" type="checkbox"/>	Date	Hr.
Occupation	CARPENTER			Dr.	FORRESTER
Cause of Fracture	FELL DISTANCE OF TWENTY FEET, LANDING ON BUTTOCK				
			X-Ray No.	24497	
EXAMINATION		TREATMENT		RESULT	
Bone	SPINE	Closed Reduction		Good	Moderate
Site	FOURTH LUMBAR VERTEBRA	Method and Position of Fixation	TAYLOR SPINE BRACE	Functional	Bad
Type:		Anesthetic Used	Yes No	Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve	
Spiral	Transverse			(a) At discharge from Hospital: Date	
Compressed	Obligate			(b) At discharge from O. P. D.: Date 9-3-26.	
Intra-Joint	Reduced			NO EVIDENCE OF MUSCLE SPASM	
Subarticular	Impacted			NO DEFINITE AREAS OF TENDERNESS	
Groove	Contracted	Open Reduction		NO INVOLVEMENT OF INNERVATION OF LEGS	
Method and Position of Fixation					
				(c) At subsequent date: Date	
				Disability: <input checked="" type="checkbox"/> Partial <input type="checkbox"/> Complete 25%	
Nature and Extent of Injury to Soft Parts especially nerves and vessels					
Was non-operative treatment tried first?					
How long after injury was operation performed?					
Was internal fixation material subsequently removed?					
X-Ray		Why		Mortality	Date
Before Reduction		IMPACTED FRACTURE 4TH LUMBAR	When	Main cause of death	
After Reduction				Absence from work: Duration	
At Discharge		HEAVY BRIDGING OF BONE AND	Period of Protection	Ability to resume job	
X-Ray Test		CALLUS BETWEEN BODIES OF 4TH & 5TH LUMBAR VERTEBRA,	Total Period of Protective Treatment	Present Wage earning capacity	
RASSERMAN TEST		- NEGATIVE.		Compensation obtained: Yes? No?	
Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion					

Form 19 A. C. S. Fracture Record System
Futura Record Company, Chicago

FIG. 276. Fracture record of case shown in Figures 273-275.

time. Early operation is very likely to cause infection and, if the only supporting structures are removed, to bring about collapse of the osseous spine and further injury to the spinal cord. If operation is delayed, a supporting bridge-work of callus is built up. If, after this bridge-work has been satisfactorily demonstrated by the roentgen ray, the patient is not making satisfactory progress, the attending physician should call in a neurologist in order that the exact extent of spinal cord involvement may be determined and the chances for relief by operative interference be estimated.

Bone transplant in certain delayed cases where initial treatment was overlooked results in considerable improvement and apparent



FIG. 277.



FIG. 278.

Figs. 277 and 278. Fracture involving 4th and 5th lumbar vertebræ, eight months after fracture, showing callus formation.



FIG. 279.



FIG. 280.

Figs. 279 and 280. Same case as Figures 277 and 278; positive callus reinforcement and solid bone formation.

SPINAL INJURIES

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cure. This is applicable to chronic cases both with and without spinal cord involvement, particularly where a chronic backache has developed.

FRACTURE RECORD			
Name C.C.	Address 57 N. DELAWARE STREET	Case No. 67271	
Age 50	Sex M	White or Colored	Date 3-6-26 Hr. 11:15 A.M.
Occupation		Hospital Entered WEST SIDE	
Cause of Fracture WORKING IN ELEVATOR SHAFT AND ONE OF THE COUNTER WEIGHTS FELL AND STRUCK HIS BACK.		First Treatment	
		Final Reduction	
EXAMINATION		TREATMENT	
Bone Involved 4th & 5th LUMBAR VERTEBRAE	Method and Posture of Fracture Closed Reduction	RESULT	
Site BODIES	Method and Posture of Fracture PLASTER SHELL TO BACK	Good	Moderate
Type	Anesthetic Used X Yes	Bad	
<input checked="" type="checkbox"/> Simple	Anatomical Result obtained HYPERTENSION AND	X	
Compound		I	
Int. Joint	CAST APPLIED		
Schaeffer's	Open Reduction		
Groves			
COMPRESSION OF 4th & 5th LUMBAR	Method and Posture of Fracture		
Description of Deformity including direction LEFT LATERAL		(a) At discharge from Hospital Date 8-16-26	
DISPLACEMENT OF 1st, 2nd, 3rd & 4th		WALKING WITH CRUTCHES. WEAR TAYLOR	
LUMBAR. ANTERIOR DISPLACEMENT BODY 4th		SPINE BRACE. ACTIVE STPHILIS.	
LUMBAR. PARTIAL COMPRESSION OF 5th LUMBAR	Anatomical Result obtained		
Nature and Extent of Injury to Soft Parts <small>(especially nerves and vessels)</small>		(b) At discharge from O.P.D. Date 3-25-27	
PARTIAL PARALYSIS LOWER EXTREMITIES	Was non-operative treatment tried first?	WALKING WITH PARALYSIS AGITANS GAIT.	
COMPLETE * * INTESTINAL TRACT	How long after injury was operation performed?	LOSS OF SENSATION PLANTAR SURFACE OF	
X-Ray	Was internal fixation material subsequently removed?	FOOT. COMPRESSION 4th & 5th LUMBAR	
Before Reduction	Why?	Mortality	Date
After Reduction		Main cause of death	
All Discharge	Period of Complete Immobilization	Absence from work	DURATION
Webermann Test FOUR PLUS	Period of Protection	*Ability to resume job	PARTIAL
	Total Period of Protective Treatment	*Present Wage earning capacity	
		Compensation obtained: Yes? No?	
<small>Form 19/A.C.S. Case Record System Farnham Company, Chicago</small>		*Black Ink: Surgeon's Orders Red Ink: Patient's Orders	

FIG. 281. Fracture record of case shown in Figures 277-280.

FRACTURES OF THE LUMBAR VERTEBRAE

TREATMENT. Fractures of the lumbar vertebrae should be treated in identically the same way as fractures of the dorsal vertebrae. In fractures of the lumbar vertebrae, however, the brace or cast may possibly have to be worn longer than in fractures of the dorsal vertebrae, since the lumbar vertebrae, outside of the muscles, are the sole support of the torso.

FRACTURES OF THE TRANSVERSE PROCESSES OF THE LUMBAR SPINE

This very common injury is usually produced by a sudden torsion or twisting of the spine and may occur unaccompanied by injury of any of the other portions of the lumbar segments.

SYMPTOMS. The symptoms include pain definitely located over the affected processes, and pain on bending in any direction, rigidity, muscle spasm, loss of stability and mobility. Occasionally there is swelling. The roentgenogram is important in helping the physician to make a diagnosis.

TREATMENT. The simpler the treatment, the more quickly the patient recovers. He should not be immobilized in a Taylor spine brace or a plaster cast, but a simple adhesive strapping should be used (see Figs. 231-234) as in cases of strain of the back muscles. The strapping should be worn for four to six weeks and then diathermy and light massage started.

These fractured transverse processes occasionally heal normally but may often become encapsulated within the muscle structures. Such imperfect healing in no way interferes with the patient's working capacity.

Many suffering from this injury show neurotic tendencies. I have seen a patient disabled for a year or longer, not because of any local affection due to this comparatively simple injury, but because of the mental effects caused by it. The possibility of a neurotic complication is, then, an excellent reason for a quick and simple form of treatment.

Litigation also influences the recovery period. One patient under my observation who had only one transverse process fractured, which was treated by the application of a cast, developed neurotic tendencies extending his recovery over a period of thirteen months. Another patient who had broken all lumbar transverse processes on both sides, and who was treated by strapping of the back only, returned to work in thirteen weeks. Hence it is advisable to simplify the treatment.

PROGNOSIS. The disability period, in cases uncomplicated by a neurotic condition, should last only two and a half or three months.

FRACTURES AND DISLOCATIONS OF THE SACRUM AND COCCYX

Injuries of the sacrum and coccyx are discussed on pages 212 to 222.

SIMPLE STRAIN OF THE BACK

HISTORY. The history is usually of lifting some heavy object.

SYMPTOMS. The symptoms are severe pain definitely localized, noticeable in bending in different directions. Absence of bone



FIG. 282. Knowles fracture cart. Head halter and body casts. (Courtesy of F. L. Knowles.)

pathology is indicated by roentgenograms and the history of occurrence.

TREATMENT. When rest in bed for a week or ten days can be had



FIG. 283.



FIG. 284.

FIGS. 283 and 284. Anteroposterior and lateral views in case of compression fracture of 3rd lumbar vertebra with complete paralysis below line of fracture. No surgery was used.

it is very helpful. However, if intelligent Swedish massage can be given immediately, it tends to eliminate any disability. Diathermy is effective as an assistant. All focal infections should be watched. (For other treatment see p. 218.)

PROGNOSIS. Disability will be from a few days to weeks and sometimes months where focal infection exists.

SPINAL INJURIES AND MALINGERING

A malingeringer may present himself who once has suffered from a genuine injury to the spine. He may have fully recovered from the effects of the injury and realize this fact; or, although the effects

have in reality disappeared, he may have developed a neurosis which leads him to believe that he is still suffering from these effects. There are other malingeringers, of course, who claim bad effects from



FIG. 285. Photograph of same patient, showing deformity at point of fracture.

an injury which never took place. The physician may have some difficulty in determining whether the patient has any justification for his complaint of continued disability. In such a case I go through the following procedure, the only one which has ever given me any satisfactory results:



FIG. 286. Photograph of same patient, showing atrophy of lower extremities due to paralysis of anterior tibial group.



FIG. 287.

FIG. 288.

FIGS. 287 and 288. Photograph of same patient, showing ability to use extremities. Patient walks with a cane and wears no prosthetic apparatus on lower limbs.

METHOD OF EXAMINING MALINGERERS. The patient is stripped and any irregularities of the spine are noted, such as kyphosis, lordosis, scoliosis or faulty weight-bearing due to a shortened limb. The patient is not asked to tell the exact place of soreness but to describe its location in a general way; i.e., in the small of the back or in the vicinity of the shoulders. The examiner then takes a soft lead pencil and, standing behind the patient, asks him to say "there," whenever the examiner presses a "sore spot." The examiner asks him no questions in order that the patient may be obliged to depend entirely upon memory as to the location of the pain. Each place of which the patient complains is then marked with the pencil. Soon there will be from two to ten marks on the patient's back: If he is a malingerer he will become confused as to the location of the soreness when the examiner repeats his pressure upon various marked spots. If there is a real injury, the patient will upon repeated pressure be able to locate without hesitation the painful areas.

If the physician is in doubt after one examination he should insist on as many more as are necessary before he feels confident of making a diagnosis.

CHAPTER XI

INJURIES OF THE PELVIC REGION

FRACTURES OF ONE SIDE OF THE PELVIS WITH OVERRIDING

PELVIC fractures are occasionally of sufficient severity to involve an entire side or both sides of the pelvis. The fracture may involve the symphysis articulation or both rami and the wing of the pelvis or the sacroiliac joint, and so may cause complete separation of one side of the pelvis from the other. One side then rides higher than the other, causing marked distortion of the pelvic ring and faulty alignment of the limb on the side showing the displacement.

Railroad workers commonly suffer from this type of injury, if they are caught, for example, between two cars or between a truck and the wall of a building or sustain a fall of considerable distance.

SYMPTOMS. Following this injury there is immediate disability accompanied by intense pain and profuse shock. Occasionally there is severe pain in the limb on the affected side, due to involvement of the peripheral nerves, and later on, paralysis. Any palpation over the sacroiliac region causes great pain. Crepitus is marked. On the affected side a definite change is seen in the apparent measurement (from the umbilicus to the internal malleolus), due to the distorted position of the pelvis. The anterior spine of the ilium is higher on one side than on the other. This will also be noted in the true measurement from the anterior superior spine of the ilium to the internal malleolus. The false measurement (umbilicus to the internal malleolus) will also show marked changes. If the urethra is involved there may be signs of blood at the urinary meatus with retention, with probable abdominal distention and tenderness.

The patient's position is symptomatic. He lies supine with the leg on the affected side drawn up to relieve muscle spasm. Roentgenograms, if taken carefully, give very definite help in the establishment of the diagnosis.

TREATMENT. A binder should immediately be carefully placed about the pelvis, and sandbags arranged about the pelvis in order to prevent further displacement. Morphine and atropine should be given to relieve shock. The patient should then be catheterized in

order to determine the presence of urethral or bladder symptoms. If rupture of the urethra prevents the passing of the catheter and the patient is suffering from extreme shock, a temporary suprapubic drainage operation should be immediately performed under local anesthesia. In cases in which shock is not extreme, the surgeon, if he considers it wise, may use a general anesthetic and repair the rupture at once. In cases in which a catheter can be passed, it is advisable to leave it in position temporarily; it may be possible to leave it for as long as three weeks, or more if asepsis is strictly observed. If there is evidence of intestinal or bladder rupture an exploratory laparotomy must be performed as soon as the patient is treated for shock. Some physicians advise an immediate exploratory laparotomy if there is the slightest suspicion of abdominal injury. Such advice is good in those cases in which it can be followed without too greatly decreasing the patient's chances for life.*

After treating for shock, if the immediate complications warrant it, a Thomas splint with a Buck's extension may be applied to the limb on the affected side. Or another form of splint may be used, which allows counter-traction on the tuber ischii of the unaffected side. A Thomas ring (Fig. 345) may be used, without causing pressure on the symphysis or tuber ischii. This ring helps to immobilize the limb on the fractured side of the body, at the same time permitting enough traction being exerted gradually to draw the fractured side of the pelvis down to its normal position. A weight of 15 to 30 lbs. is necessary, and occasionally a greater weight for a well-muscled patient. This form of traction immobilization must be carried out for at least three months, or as long as there is any pain in the region of the pelvis upon manipulation. In conjunction with this a snug body binder should be used. At first, every ten days to two weeks roentgenograms should be taken and measurements made to determine the rate of progress in drawing the pelvis down. Weight-bearing with crutches can be attempted only after complete disappearance of pain and then a belt such as a Goldthwait can be worn to advantage.

COMPLICATIONS. After weight-bearing has been started, these patients sometimes complain of severe pain about the sacroiliac joint. This is due to a failure of the bone or symphysis to heal. An

* Young, H. H., and Waters, C. A. *Urological Roentgenology*. Hoeber, N. Y., 1928.

arthrodesis of the symphysis is then advisable, by removal of the intercartilaginous disc at the symphysis, freshening the surface and obtaining bony union, either by means of bone inlay or wiring, or



FIG. 289. Extensive fracture of right pelvis with overriding of entire side. Note variation at symphysis. (See chart, Fig. 292.)

both. If pain and disability continue, arthrodesis of the sacroiliac joint becomes necessary.

If this form of fracture occurs in a woman, she should be advised that in the event of pregnancy a cesarean section might become necessary.

Again, some of these patients, after weight-bearing has been begun, complain of pain in the small of the back. Building up the



FIG. 290.

FIG. 291.

FIG. 290. Same case as Figure 289. Note tilting of pelvis and surgical scar for drainage of kidney.

FIG. 291. Same case as Figures 289 and 290. Note obliteration of gluteal line on right side.

FRACTURE RECORD					
C.C.		Address		Case No. 49617	
Name		M. S. W. D.	White or Colored	Date	1941
Age	50	Sex	M. F.	Hospital Entered	ST. LUKES HOSP.
Occupation		Cause of Fracture		First Treatment	3-28-24
				Final Reduction	
EXAMINATION		TREATMENT		RESULT	
Bone PELVIS, RIGHT ILLIUM AND PUBIS		Closed Reduction		Good	Moderate
Site		Method and Position of Fixation BRADFORD FRAME		Bad	
Type:		TRACTION ON SHORT LEG.			
Simple		Anesthetic Used Yes No			
Compound		Anatomical Result obtained			
Fracture Joint					
Spatioarticular					
Subluxated					
Greenstick					
Comminuted		Open Reduction			
		Method and Position of Fixation			
Description of Deformity including shortening		MULTIPLE FRACTURES PRESENT.		(a) At discharge from Hospital Date 9-17-24	
UPWARD DISPLACEMENT OF ENTIRE RIGHT SIDE OF PELVIS, SEPARATION ALONG RIGHT SACRO-ILLIAC JOINT.		COMPLICATIONS PERINEPHRITIC ABSCESS WITH OPERATION, BLADDER CALCULI AND ANATOMICAL RESULT obtained. SEVERE CYSTITIS MADE TREATMENT DIFFICULT.		NO ATROPHY OF MUSCLES OF LEG.	
SHORING 2 IN. RIGHT LEG.				1 INCH SHORTENING WEARING CORRECTION SHOE	
Nature and Extent of Injury to Soft Parts				WALKS WELL	
Extremely severe and extensive				(b) At discharge from O. P. D. Date 4-6-25	
BLADDER FUNCTION DISTURBED.		Was non-operative treatment tried first?		NO ATROPHY OF MUSCLES OF LEG.	
		How long after injury was operation performed?		WEARING CORRECTION SHOE	
		Was interval fixation material subsequently removed?		WALKS WELL	
X-Ray		Why?		(c) At subsequent date Date	
Before Reduction UPWARD DISPLACEMENT R. PELVIS.		When		Disability: <input checked="" type="checkbox"/> PARTIAL <input type="checkbox"/> TOTAL	
After Reduction THE UPWARD DISPLACEMENT SACRO-ILLIAC WAS REDUCED.		Period of Complete Immobilization 2 ¹ / ₂ MONTHS		RETURNED TO NORMAL WORK AS ROOFER	
		Period of Protection 5 ¹ / ₂ MONTHS			
Wassermann Test		Total Period of Protective Treatment 8 MONTHS		Mortality Date	
		APPROXIMATELY		Main cause of death	
*Black Ink: Surgeon's Conclusion Red Ink: Patient's Conclusion					

Form 19/A. C. B. Case Record System
Futura Company, Chicago

FIG. 292. Fracture record of case shown in Figures 289-291.

FIG. 293.

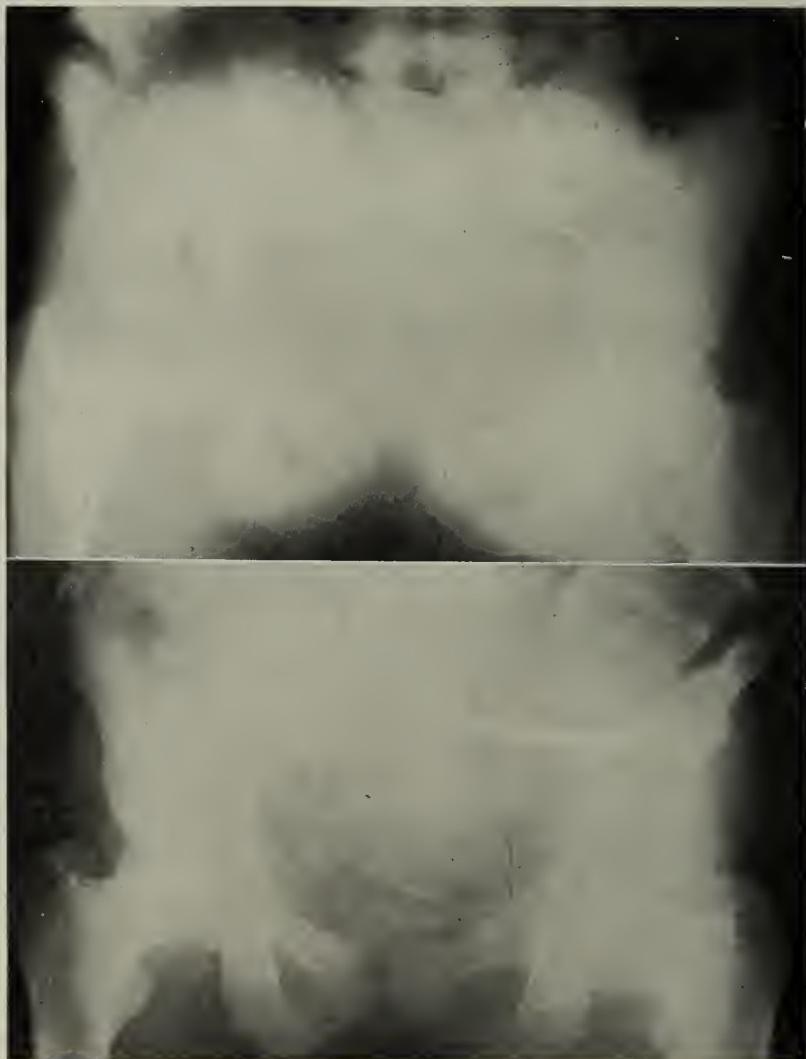


FIG. 294.

FIG. 293. Fracture of wing of right ilium and sacroiliac separation with overriding symphysis. Partial rupture of urethra. Treatment: traction and abduction with retained catheter.

FIG. 294. Same case as Figure 293. Result of traction and abduction treatment.

PELVIC INJURIES

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shoe on the injured or short side of the body very often completely eliminates this type of pain.*

PROGNOSIS. Prognosis should be guarded in this form of injury,

FRACTURE RECORD					
Name	H.B.	Address	Case No.	86124	
Age	26	Sex	M.	Date	— Hr.
Occupation		M. S-W-D.	White or Colored	Drs.	FORRESTER & LYMAN Per H.O. BEGGS
Cause of Fracture	AUTOMOBILE COLLISION AND HE WAS THROWN FORWARD			Time of Occurrence of Accident	7-6-27
				Hospital Entered	WEST SIDE HOSPITAL
				First Treatment	7-6-27
				X-Ray No.	32457
				Final Reduction	
EXAMINATION		TREATMENT		RESULT	
Bone	RIGHT ILLUM	Closed Reduction		Good	Moderate
Site	PELVIC BONES	Method and Position of Fixation		Bad	
Type:		BUCKS EXTENSION TO RIGHT LEG.		X	
Simple	Transverse	Anesthetic Used	Year	Description of End Result, including Disability, Shortening, Function, Pain, Swelling, Nerve	
Compound	Obligate <input checked="" type="checkbox"/>	Anatomical Result obtained		(a) At discharge from Hospital Date 8-12-27	
Late Joint	Spiral	GOOD		WALKED WITH AID OF CRUTCHES. DID NOT	
Displaced	Injected			BEAR ANY WEIGHT ON RIGHT LEG.	
Groin	Comminuted	Open Reduction			
Method and Position of Fixation					
Description of Deformity including shortening					
DEFORMITY OF PELVIC BONES WITH SEPARATION					
OF SYNPHTYSIS AND SHORTENING OF RIGHT					
LEG.					
Anatomical Result obtained					
(b) At discharge from O.P.D.: Date 1-17-28					
1/4 INCH SHORTENING. RIGHT LEG FREE,					
AND COMPLETE MOTION IN HIP KNEE AND					
ANKLE JOINTS.					
Nature and Extent of Injury to Soft Parts					
especially nerves and vessels					
(c) At subsequent date Date					
INJURY TO URETHRA. EXTRAVASATION OF					
BLOOD INTO SOFT TISSUES.					
Was non-operative treatment tried first?					
Disability: Absent. Partial. Complete 8 MONTHS					
How long after injury was operation performed?					
TOTAL 8 MONTHS					
Was internal fixation material subsequently removed?					
PARTIAL ABOUT 2 MONTHS					
X-Ray	Why	Mortality		Date	
Before Reduction	SHOWS WIDE SEPARATION SYNPHTYSIS	When		Main cause of death	
After Reduction	SHOWS SEPARATION REDUCED	Period of Complete Immobilization		Absence from work: Duration	
At Discharge	LITTLE OR NO SEPARATION	12 WEEKS		*Ability to resume job	
Wassermann Test	NEGATIVE	Period of Protection		*Present Work earning capacity	
		Total Period of Protective Treatment		Compensation obtained: Yes? No?	
12 WEEKS					
*Black Ink: Surgeon's Order Red Ink: Patient's Order					

Form 19 A. C. S. Case Record System
Futura Company, Chicago

FIG. 295. Fracture record of case shown in Figures 293 and 294.

as in all other pelvic injuries with the exception of fracture of the crest of the ilium. The disability period ordinarily lasts from nine months to a year. The mortality rate is not as high as would be expected, particularly where definite, intelligent treatment is followed in the early stages.

FRACTURE OF A RAMUS OF THE PUBIC BONE

SYMPTOMS. This not uncommon fracture, which is produced by direct violence to the pelvis, is characterized by immediate pain at the point of fracture, and by effusion and muscular spasm. There is seldom crepitus. The patient is able to walk, but only with considerable difficulty. Seldom, if ever, are the abdominal organs or

* Frequently, even with the best of care, there will be shortening on the affected side.

the bladder and urethra involved, but as a routine matter of precaution these patients should be catheterized. Roentgenograms, which should always be taken from different angles, aid in diagnosis, but measurements are of no help.

TREATMENT. A body binder, either of heavy muslin supported by adhesive outside the muslin, or a Goldthwait belt, should be applied and the patient kept at rest for two to three weeks. At the end of this period he may walk about freely and, after four to six weeks or even earlier, is ready for work.

PROGNOSIS. The disability period lasts for three to six weeks and causes no specific loss of function.

FRACTURE OF BOTH RAMI OF THE PUBIC BONE

SYMPTOMS. The symptoms are the same as for fracture of a single ramus, except that disability is immediate and there may be shock. The chances for abdominal or bladder and urethral complications are also increased.

TREATMENT. A tight binder to support the entire pelvis should be applied at once and sandbags placed about the pelvis. Catheterization should be performed immediately. Exploratory laparotomy should be considered if there is persistent distention or other sign of abdominal complications. If no complications appear, rest in bed for eight to ten weeks is usually sufficient. Weight-bearing, with the assistance of crutches, may be begun at the end of two and one-half to three months and complete weight-bearing at the end of three and one-half to four months.

PROGNOSIS. These patients, if there are no complications, may return to work about four months after injury and they will suffer no specific loss of function.

SIMPLE FRACTURES OF THE ILIUM, INVOLVING THE CREST

These fractures, as a rule, involve simply the wing of the pelvic bone, without in any way affecting the pelvic arch, except at the line of fracture. The fracture causes very little displacement because the strong muscular attachments act as a natural splint.

SYMPTOMS. The symptoms include marked tenderness in the region of the fracture, muscular spasm, occasionally effusion and crepitus. With some assistance, the patient is usually able to walk

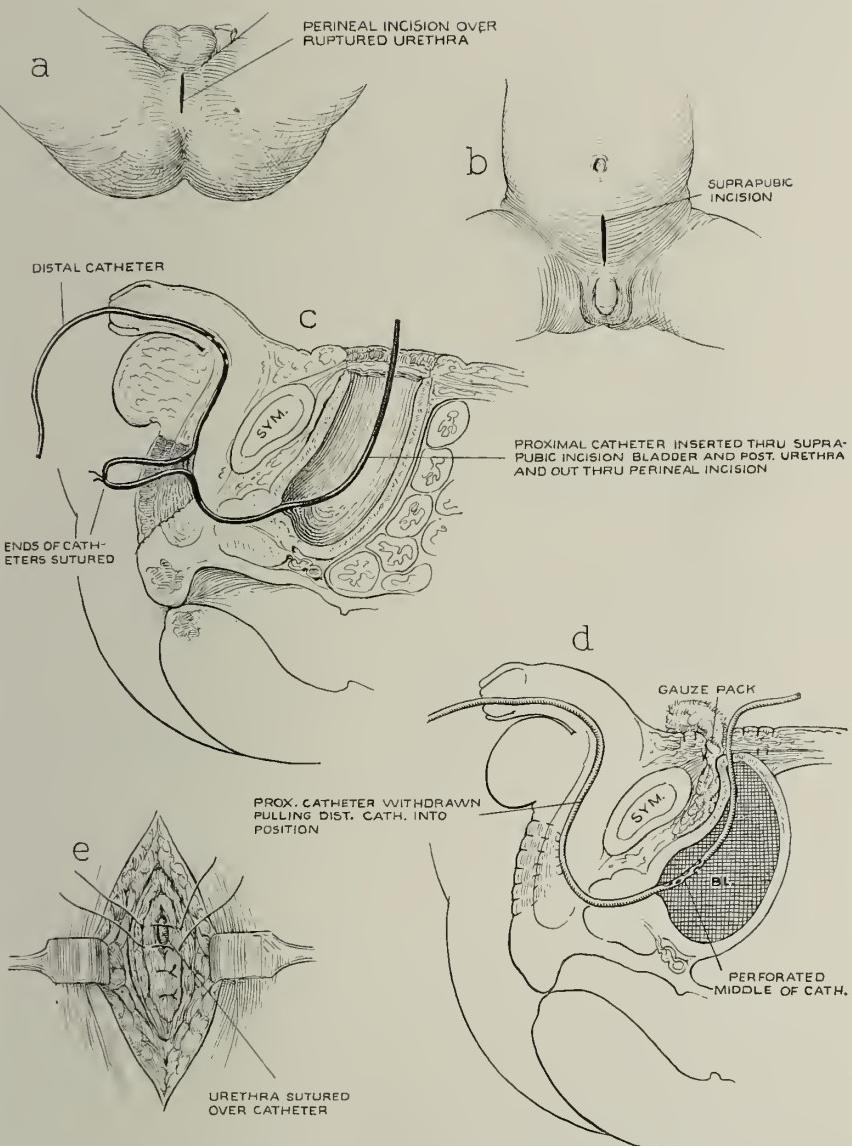


FIG. 296. Repair of traumatic rupture of urethra.

after the injury. Roentgenograms, taken from several angles, help to make the diagnosis clear.

TREATMENT. The form of treatment is simple. A tight binder made of adhesive, or a flannel binder or canvas belt reinforced with an outer covering of adhesive, may be applied. In a number of cases I have allowed these patients to rest in bed without applying any type of binder. Rest in bed over a period of eight or ten weeks is usually sufficient. Weight-bearing may be attempted twelve weeks after injury, and should at first be tried only with the aid of crutches. Massage may be helpful during the first month of attempts at weight-bearing.

PROGNOSIS. The patient will be disabled for four to six months but will suffer from no specific loss of function after treatment is completed.

FRACTURES OF THE ACETABULUM INVOLVING THE BRIM OR THE CENTRAL PORTION

Fractures involving the brim or the cuff of the acetabulum, with displacement of a portion of the brim, are not uncommon. There may also occur fracture through the central portion of the acetabulum, without displacement.

SYMPTOMS. There are well-defined pain, muscle spasm and limitation of motion on internal rotation, flexion and extension. Crepitus is seldom, if ever, present. The patients usually can walk if assisted, but only with difficulty. There are occasional changes in the true measurement (from the anterior superior spine of the ilium to the internal malleolus) or in the apparent measurement (from the umbilicus to the internal malleolus). The accompanying roentgenogram (Fig. 303) showing a dislocation on one side with fracture of the acetabulum without dislocation on the other showed a true shortening of $\frac{1}{2}$ inch after dislocation was reduced and measurements taken. The roentgenogram is an important supplement to the symptoms in making a diagnosis.

TREATMENT. The simplest form of treatment consists in the application of a Thomas splint (p. 254). The distal end of the splint is attached to the foot of the bed, with counterextension in the form of Buck's appliance and a pull of 15 to 20 lbs. on the leg, depending on the muscular development of the individual. Hyperabduction

should also be used, and should be increased as the muscular spasm and soreness disappear. Occasionally it is advisable to administer an anesthesia and resort to forcible reduction using a Hawley table or some similar form of mechanical traction. This form of treatment draws the head of the femur away from the acetabular cavity, stretches the capsule and automatically brings the fragments into alignment. It also prevents cicatricial contraction and fibrosis, and it relieves pain almost immediately.

The Thomas splint should be worn for at least six to eight weeks, or in cases of extensive fracture, for ten or twelve weeks. Passive and active motion are advisable. The chances for permanent loss of motion are then considerably lessened.

Where the displacement is severe it is not unusual to find a peripheral nerve lesion (p. 414). In the case shown here (Fig. 303) of the dislocation on one side and fracture on the other there is a complete paralysis of the anterior tibial nerve which materially prolongs the disability.

PROGNOSIS. The disability period extends over four to six months, and generally is followed by no specific loss of function. If permanent limitation of motion does occur, it usually is in connection with external and internal rotation of the femoral head and flexion on the abdomen, except, as stated above, where there is a peripheral nerve lesion, in which event there is nine months to a year or longer of disability. When there is an associated nerve lesion a prosthetic apparatus such as a drop-foot shoe with an ankle check can be worn, thereby permitting earlier return to work.

FRACTURE OF THE ACETABULUM WITH PENETRATION OF THE HEAD OF THE FEMUR THROUGH THE ACETABULAR CAVITY

This rare injury, of which I have had only 3 cases, is difficult to treat, and is very apt to cause some permanent limitation of motion in the hip joint.

SYMPTOMS. After a direct fall, or a blow on the greater trochanter, or after an accident in which the body has been rolled or crushed, this fracture of the acetabulum manifests itself by the symptoms of intense pain and shock and deformity of the limb, usually accompanied by external or internal rotation of the entire limb, depending upon the direction and degree of violence. There is total rigidity

FIG. 297.



FIG. 298.



FIG. 297. Fracture of all four rami. Roentgenogram taken at time of injury.
FIG. 298. Same case as Figure 297, four months later.

of the hip joint with marked tenderness, upon palpation, about the entire joint. Occasionally effusion takes place into the inguinal space. There is no crepitus. A distinct change in the true measure-

FRACTURE RECORD					
Name <u>J.A.A.</u>	Address	Case No. <u>b539b</u>			
Age <u>40</u>	Sex <u>M</u>	White or Colored	Date <u>Mr.</u>		
Occupation			Dr. <u>_____</u>		
Cause of Fracture <u>CAVE-IN OCCURRED, CATCHING MAN IN HEAVY CLAY AND CAUSING INJURY ABOUT RIGHT SIDE OF BODY.</u>		Time of Occurrence of Accident	<u>9-14-25</u>		
		Hospital Entered			
		First Treatment			
		Final Reduction			
EXAMINATION		TREATMENT	RESULT		
Bone <u>RAMION BOTH PUDIC BONES</u>		<u>Closed Reduction SIMPLY BY REST IN BED</u>	<u>Good</u>	<u>Moderate</u>	<u>Bad</u>
Site		<u>W-750 End Position of Ramion ABOUT A MONTH</u>			
Type:					
Stable	Tranverse	<u>Anesthetic used</u> <u>----- Yes ----- No</u>	Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve		
Compressed	Oblique	<u>Anatomical Result obtained</u>	(a) At discharge from Hospital, Date <u>3-15-26</u>		
Free Joint	Spiral		RECOVERY OF PELVIC FRACTURE		
Subluxated	Impacted		COMPLETE		
Grievous	Comminuted	<u>Open Reduction</u>			
		<u>Internal and External Fixation</u>			
Description of Deformity including shortening			(b) At discharge from O.P.D., Date		
<u>LITTLE DISPLACEMENT</u>					
		<u>Anatomical Result obtained</u>	<u>BECAME AMBULATORY.</u>		
Nature and Extent of Injury to Soft Parts especially nerves and vessels		<u>WORE GOLDOOTHWAITE BELT FOR</u>			
		<u>SEVERAL WEEKS.</u>	(c) At subsequent date, Date		
		<u>Was non-operative treatment tried first?</u>	Disability: <u>Absent, Partial, Complete</u>		
		<u>How long after injury was operation performed?</u>			
		<u>Was internal fixation material subsequently removed?</u>			
X-Ray		Wby	Mortality	Date	
Before Reduction		Where	Main cause of death		
After Reduction		Period of Complete Immobilization	Absence from work: <u>Duration</u>		
At Discharge		Period of Protection	*Ability to resume job		
Wassermann Test		Total Period of Protective Treatment	*Present Wage earning capacity		
			Compensation obtained: <u>Yes? _____ No? _____</u>		
			<u>Black Ink: Surgeon's Opinion</u>	<u>Red Ink: Patient's Opinion</u>	

Form 19 (A. G. S. Case Report System)
Northern Company, Chicago

FIG. 299. Fracture record of case shown in Figures 297 and 298.

ment (from the anterior superior spine of the ilium to the internal malleolus) is apparent.

TREATMENT. The treatment is divided into two parts. The first includes treatment for shock. Morphine and atropine are administered directly after the accident, and for thirty-six hours the patient is kept absolutely quiet, no attempt being made to manipulate the limb. Unless urine is voided naturally, catheterization should be done to determine the existence of any bladder or urethral complication.

The second part of the treatment consists in the reduction of the fracture. This should not be attempted until all evidence of shock has subsided. It is highly advisable, before attempting reduction, to explain to the patient that there is grave possibility of failure following the attempt at closed reduction. In the event of failure,



FIG. 300.



FIG. 301.

FIG. 300. Simple fracture of ilium involving crest.

FIG. 301. Same case as Figure 300. Callus demonstrated in two months.

FRACTURE RECORD

Name	F.R.	Address	1010 S. ABERDEEN STREET	Case No.	58442
Age	45	Sex	MALE	M.	Male
Occupation	LABORER	Method and Position of Fixation	White or Colored	Time of Occurrence of Accident	7:45 A.M.
Cause of Fracture	CRUSHED BETWEEN A TRUCK AND WALL			Hospital Entered	4-17-26
				First Treatment	4-17-26
			X-Ray No.	27389	Final Reduction
EXAMINATION			TREATMENT		
Bone	IRREGULAR FRACTURE LEFT ILIUM.	Method	Closed Reduction	IMMOBILIZED.	RESULT
Site	WING LEFT ILIUM. THIN BODY OF BONE.	Position	Method and Position of Fixation	BODY BINDER AND	Good
Type	IRREGULAR			TOMAS SPLINT WITH TRACTION.	Moderate
X-Style	Transverse	Anesthetic Used	NO	Yes	Bad
Compound	Oblique	Anatomical Results obtained	GOOD		
Intra-Jelat	Spiral				
Subcortical	Imported				
Growth	Consolidated	Open Reduction	NO		
Description of Deformity (including shortening)			Method and Position of Fixation		
SLIGHT					
			(a) At discharge from Hospital: Date MAY 10, 1926.		
			WITH CRUTCHES		
Nature and Extent of Injury to Soft Parts <i>(especially nerves and vessels)</i>					
SUPERFICIAL BRUISES LEFT THIGH			Was non-operative treatment tried first? YES		
			How long after injury was operation performed?		
			Was internal fixation material subsequently removed?		
X-Ray			Why		
Before Reduction			Where		
After Reduction			Period of Complete Immobilization 23 DAYS		
At Discharge			Period of Protection		
Wassermann Test NEGATIVE			Total Period of Protective Treatment		
			*Ability to resume job YES		
			*Present Wage earning capacity SAME		
			Compensation obtained: Yes YES No?		
			*Black Ink: Surgeon's Choice Blue Ink: Patient's Choice		

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FIG. 302. Fracture record of case shown in Figures 300 and 301.

open interference will be necessary. The patient's consent should be obtained for immediate performance of an operation for reduction, should the closed method prove impossible. His consent eliminates the necessity of attempting reduction at two separate intervals, an unsatisfactory procedure from the standpoint of both patient and surgeon.

The patient should be placed on a Hawley table, with a perineal pad well fixed against the symphysis, to permit countertraction and full abduction of both limbs. Under complete anesthesia, with the limb abducted at from 60 to 80° flexion, gentle, increasing traction, and then a gentle, twisting motion of the thigh should be made, with the purpose of disengaging the head of the femur. There are cases in which penetration of the head is complete. In one of my cases, in which abduction was contraindicated, a straight pull with traction laterally by means of a heavy band around the leg close to the perineum was found more practical. It will take a great deal of traction to obtain any result. When the fracture is reduced, apply a Thomas splint with a Buck's extension (p. 254) with the limb in full abduction, the extension being placed from the upper third of the thigh downward. A body cast with traction can be used in these cases.

Occasionally, it will be impossible to reduce a fracture by this method; in such cases an open operation must be performed. The technique of the open operation consists, while the patient is on the Hawley table, in preparing the abdomen as for a laparotomy. An incision should be made about 1 inch from the anterior superior spine of the ilium, running downward on a line with Poupart's ligament, as shown in Figure 308. This incision should pass through the muscular structures but should not penetrate the peritoneum. The peritoneum should be drawn to one side toward the median line, and the operation conducted *extraperitoneally*. Such an incision affords an excellent exposure of the displacement. By means of the traction apparatus and the Lane bar, pressure may then be exerted from within against the head of the femur, and the fracture reduced. It may be necessary to remove some of the osseous structure in order to effect reduction. Such osseous fragments should be saved, so that after reduction they may be replaced to aid in rebuilding the floor of the acetabulum. After reduction is effected and the tissues

closed, a Thomas splint and a Buck's extension should be applied, just as in the cases of closed reduction described (p. 211).

When reduction is obtained by means of the closed method, the splint should be kept on for at least two and one-half to three months. If surgically effected, the splint should be worn for three months or more, depending upon the rate of healing as demonstrated by the roentgen ray. The traction should be followed by massage. Weight-bearing should be attempted not earlier than the fourth month, and then only with the aid of crutches.

It is important, in all such cases, where extension is applied above the knee, to keep the knee in a position of 10° flexion, with the foot at right angles.

PROGNOSIS. The disability period lasts for six or eight months, and sometimes for a year. The patient is apt to suffer from a certain degree of permanent limitation of motion, depending upon the severity of the injury. This limitation is apparent upon flexion on the abdomen and upon rotation and abduction.

COMPLETE AND PARTIAL DISLOCATION OF THE SACROILIAC JOINT ACCOMPANYING FRACTURE

Complete dislocation of the sacroiliac joint occurs only when the injury is so severe that it also causes a fracture and a tearing away of the muscular attachments of the joint. Partial or complete dislocation, then, is always associated with fracture (see Fig. 293).

SYMPTOMS. The symptoms include immediate incapacity, extreme pain, shock, pelvic deformity, muscle spasm and lack of mobility. There is a very definite change in the true measurement (from the anterior superior spine of the ilium to the internal malleolus) and in the apparent measurement (from the umbilicus to the internal malleolus). Roentgenograms are important supplements to these symptoms in making a diagnosis. They show not only the sacroiliac change but also any change at the symphysis pubis. There may be abdominal distention and tenderness, with possible areas of dullness evidencing internal hemorrhage. In this event, immediate surgical intervention must be seriously considered. Where the case is a good surgical risk it is better to perform an exploratory operation than to procrastinate.

TREATMENT. The patient should be placed on some kind of a level bed, either a fracture bed or one with boards underneath it to hold him in an extended position. He should be then treated for shock

FIG. 303.



FIG. 304.

FIG. 303. Obturator dislocation on one side with comminuted fracture of acetabulum on other.

FIG. 304. Reduction of dislocation and effect of forced traction and abduction on fractured acetabulum.

with morphine and by the application of heat to the extremities. Immediate catheterization should be done to determine any bladder

or urethral complications. Sandbags should be placed about the body and the patient kept absolutely at rest for thirty-six to seventy-two hours.

After reduction* of the dislocation and fracture the most reasonable appliance for these cases is either an adhesive band molded about the pelvis, or a flannel binder, and a Thomas splint with a Buck's extension and a counterweight over the bed. If possible, however, a splint in which the ring presses on the pubic bone of the uninjured side should be used, for it is more effective than the Thomas splint. If a Thomas splint is used, the ring should not press against the tuber ischii but should be held 3 to 4 inches away from it. Also, when using a Thomas splint, a linen sheet can be passed between the limbs and pulled up against the tuber ischii on the other side of the pelvis and attached to the head of the bed. If these directions are followed, the injured side of the pelvis is gradually pulled down into the proper alignment (the usual direction of the dislocation is upward). Extension should be done gradually so as to cause little muscle spasm and discomfort to the patient. The splint should be kept on for at least two and one-half or three months. Weight-bearing should not be attempted for four months after injury and then only with the help of a body binder, such as a Goldthwait belt, and crutches.

If toward the close of the period of treatment the patient complains of pain in the hip or the small of the back, or both, it may be ascribed to faulty weight-bearing. A shoe which is raised on the heel and sole, or built up inside, must then be worn. The surgeon must expect a varying degree of permanent shortening in this type of fracture case.

Complications to be watched for are:

1. Possible peripheral nerve lesions.
2. Infection of the bladder with ascending involvement of the kidneys (in one of my cases both kidneys were involved).
3. Septic pelvic peritonitis.

PROGNOSIS. Disability lasts from six months to a year and as a rule some degree of shortening of the limb will result. The apparent

* Reduction can be made by giving a general anesthetic and using direct traction, following it up by a Buck's extension on that side. Shock can be lessened by the use of spinal analgesia for the reduction, thereby eliminating the complications accompanying general anesthesia. (See Evans, C. H. Spinal Anesthesia. Hooper, N. Y., 1920.)



FIG. 305. Fracture of acetabulum showing displacement, treated by abduction with traction.



FIG. 306. Same case as Figure 305, six weeks later. (See chart, Fig. 307.)

FRACTURE RECORD

Name J. W.	Address	Case No. 00001	
Age 34 Sex M	M. S. M.-D.	Date 1-12-26 M.	
Occupation WAGON DRIVER		Hospital Entered COKE COUNTY	
Cause of Fracture SLIPPED UNDER WAGON AND WHEEL RAN ACROSS HIS LEFT HIP		First Treatment	
	X-Ray No. 25772	Final Reduction	
EXAMINATION		TREATMENT	RESULT
BONE ILIUM AND ISCHIUM		Closed Reduction	Good Moderate Bad
Site ACETABULUM - INTO JOINT		Method and Position of Position KEPT IN BED WITH	X
Type:	TRACTOR AND SEDUCTION.		
Simple X	Transverse	Anesthetic Used Yes	X
Compound	Oblique	Anatomical Result obtained	
Intra Joint X	Spiral		
Subluxated	Displaced		
Grossly	Comminuted	Open Reduction	
Description of Deformity including shortening		Method and Position of Position	
NONE			(a) At discharge from Hospital Date
			(b) At discharge from O. P. D. Date
			FAILED TO RETURN 4-8-26
Nature and Extent of Injury to Soft Parts especially nerves and vessels		Anatomical Result obtained	
NONE			(c) At subsequent date Date
			Disability: Absent, Partial, Complete
X-Ray FRACTURE OF ILLUM AND ISCHIUM INTO		When	Mortality Date
Joint Reduction ACETABULUM			Main cause of death
After Reduction		Period of Complete Immobilization	Absence from work: Desiring
At Discharge AMPLE CALLUS FORMATION		Period of Protection	*Ability to resume Job
Wassermann Test NOT DONE		Total Period of Protective Treatment	*Present Wage earning capacity
			Compensation obtained: Yes? No?
			*Black Ink: Screw & Osteos. Red Ink: Perfect Option

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FIG. 307. Fracture record of case shown in Figures 305 and 306.

measurement is affected in these cases, the true measurement showing little or no change. Death is always imminent.

STRAIN OF THE SACROILIAC JOINT VERSUS TEARING OF THE ERECTOR SPINAES MUSCLES

For a number of years strain of the sacroiliac joint has been considered a definite lesion and has been treated as such by all surgeons and orthopedists. The roentgen ray has failed, however, to diagnose a change in the joint. (In discussing this condition it must be understood that I refer only to traumas of adult patients whose bony growth is completed.) I also treated patients for sacroiliac strain but found my results far from satisfactory and disabilities continuous, indefinite and disheartening. I therefore concluded that there must be some other lesion and decided it was possibly a muscle tear, probably affecting the erector spinae group. While in England I discussed this possibility with Sir Robert Jones who concurred with my opinion and wrote me confirming his findings. About three years ago I again discussed the problem with a New York orthopedist who advised me that although he had been an ardent believer in sacroiliac strain he was becoming convinced that it was a muscle condition with focal infection a contributing factor.

I therefore began to give especial attention to the examination of these cases and found in each instance a definite repetition of pain over the erector spinae muscles at the posterior sacrosciatic notch, usually on one side only. I then worked out a course of treatment suggested to me by Sir Robert Jones which has produced very satisfactory results.

SYMPTOMS. The symptoms of this injury include definite pain at the posterior sacrosciatic notch, rigidity, muscle spasm and loss of mobility, the patient being able to walk, but only with difficulty. Roentgenograms should be made in order to eliminate the possibility of fracture or dislocation.

TREATMENT. The treatment includes the application of heat, diathermy and Swedish massage for a period of five or six weeks. In cases in which diathermy and Swedish massage are not available, the surgeon must resort to heat and hand massage applied by himself.

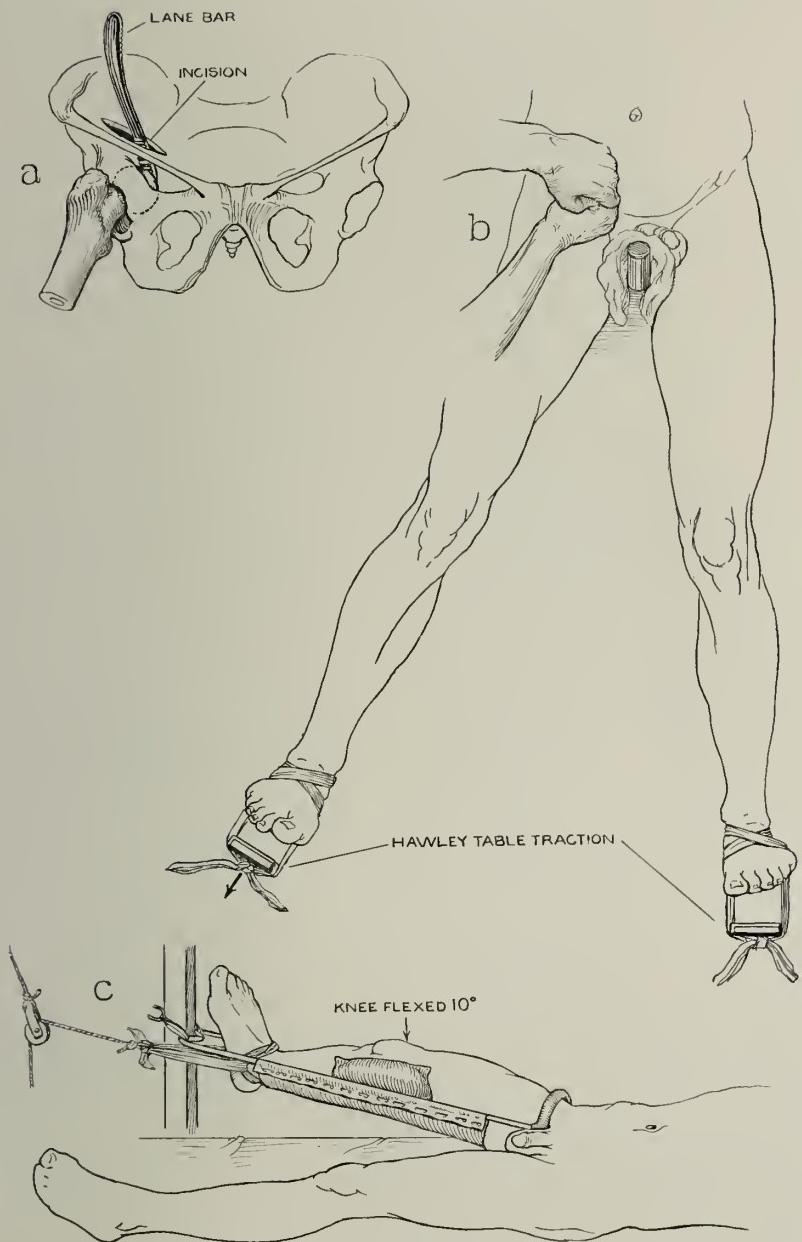


FIG. 308. Perforation of femoral head through acetabulum and method of surgical reduction where traction alone fails. Cast should always be applied while traction is still on.

If cases do not yield promptly to treatment the complications of neurosis and systemic poisoning must be considered. Some neurotic patients are cured by the application of a Goldthwait belt or some other support for the back. Others become well after the surgeon has suggested to them the unpleasant procedure of wrenching the back.

In persistent cases where systemic poisoning from infected tonsils or some other infected source is a factor, such must be eliminated before the pain in the erector spinae muscles will cease. One of my cases was that of a young girl who, two years previously, had fallen and who subsequently had suffered from pain in the erector spinae muscles. The condition did not improve under treatment with heat and massage. A thorough physical examination showed badly infected tonsils. Tonsillectomy was followed by entire disappearance of pain in the erector spinae muscles.

Some patients, however, who show no signs of neurosis or systemic infection fail to improve under local treatment. Wrenching of the back is successful in many of these cases. After this procedure, the patient should be kept in bed in a position of hyperextension for at least four or five days before walking about. (See Figs. 224-226.)

PROGNOSIS. In uncomplicated cases the disability period extends over five or six weeks. No definite disability period can be estimated in cases complicated by neurosis or systemic infection. In cases in which wrenching of the back is done, the patient should be able to return to work a month to six weeks after the operation.

FRACTURES OF THE SACRUM

SYMPTOMS. The symptoms of this fracture, which is the result of a crushing injury or a fall, are immediate inability to move, pain and tenderness on pressure, effusion into the tissues and sometimes ecchymosis. Crepitation is infrequent. In severe cases there are symptoms of shock and the apparent measurement (from the umbilicus to the internal malleolus) shows a deviation from normal. Roentgenograms supplement the symptoms in establishing of the diagnosis.

TREATMENT. The treatment includes rest in bed, with the patient in a position of hyperextension, and the application of a tight



FIG. 309. Simple contusion with hemorrhage followed by myositis ossificans.

FRACTURE RECORD					
Name	J.P.	Address	MELROSE AVENUE, CLEX ELLYN	Case No.	63310
Age	51	Sex	M	Time: Occurrence of Accident	8-1-25
Occupation	CARPENTER			Hospital Entered	WEST SUBURBAN
Cause of Fracture	FELL FROM ROOF 20 FEET			First Treatment	8-1-25
		X-Ray No.	25988	Final Reduction	
EXAMINATION		TREATMENT		RESULT	
Bone	SACRUM	Closed Reduction		Good	Moderate
Site	PELVIS	Method and Position of Fixation		X	
Type:		NO REDUCTION		X	
Simple	X Transverse	Anesthetic Used	Yes		
Compound	Oblique	f Anatomical Result obtained			
Into Joint	Spiral			(a) At discharge from Hospital; Date	8-5-25
Subperiosteal	Impacted			PAIN ABOUT COCCIX AND SACRUM	
Gummatus	Comminuted	Open Reduction			
		Method and Position of Fixation			
Description of Deformity including shortening		MORE			
				(b) At discharge from O.P.D.; Date	
				HARD MASS OVER RIGHT ISCHIAL TUBEROSITY	
				CICATRICIAL TISSUE RESULT OF HEMATOMA	
Nature and Extent of Injury to Soft Parts especially nerves and vessels					
HEMATOMA OF SOFT TISSUES OF BUTTOCKS		(c) At subsequent date; Date			
		Was non-operative treatment tried first?	Disability: severe; Partial; Complete 10 WEEKS		
		How long after injury was operation performed?	PARTIAL 8 WEEKS		
		Was internal fixation material subsequently removed?			
X-Ray		Why	Mortality Date		
Before Reduction	NO REDUCTION	When	Main cause of death		
After Reduction		Period of Complete Immobilization	1 MONTH	Absence from work: Duration	
At Discharge	ALIGNMENT PERFECT	Period of Protection	8 WEEKS	*Ability to resume job YES	
Wassermann Test	NEGATIVE	Total Period of Protective Treatment		*Present Wage earning capacity SAME	
				Compensation obtained: Yes? <input checked="" type="checkbox"/>	
Form 19 (A, C, S) Case Record System Futura Company, Chicago					
*Black Ink = Surgeon's Opinion Red Ink = Patient's Opinion					

FIG. 310. Fracture record of case shown in Figure 309.

binder of flannel or muslin reinforced on the outside by adhesive tape; or, if a Goldthwait belt is easily procurable, it should be applied immediately after injury. The body binder should be worn for ten days or two weeks, and then a Goldthwait belt should be worn for three to four months. The patient must remain quietly in bed for at least eight weeks. Gradual weight-bearing, with the aid of crutches, may then be begun. Gentle massage is of value. In the exceptional cases exhibiting shortening of one limb a suitably built-up shoe must be worn.

PROGNOSIS. The disability period extends over four to six months and only in exceptional cases is there any permanent shortening, necessitating the wearing of a built-up shoe.

FRACTURES AND DISLOCATIONS OF THE COCCYX

Fracture or dislocation of the coccyx is caused by a direct fall, with the individual in a sitting position, or by the coccyx coming in contact with a hard substance while the individual is astride an object. Dislocation is of more common occurrence than fracture. Fracture generally occurs in the articulation of the sacrum with the coccyx and is not shown by the roentgen ray.

SYMPTOMS. The symptoms include intense local pain which is increased on defecation or on slight contraction of the sphincters. Preternatural mobility is determined by insertion of the index finger in the rectum and manipulation of the fragments. Sometimes, however, the pain is so intense that the physician cannot perform this kind of manipulation. Roentgenograms confirm the diagnosis except in cases of fracture in the articulation of the sacrum with the coccyx, in which definite bone change will be found.

TREATMENT. Treatment consists in readjustment of the fragments as soon as possible after the diagnosis is made. This readjustment can be effected by inserting the index finger in the rectum and, with the thumb and finger, replacing the fragments in their normal position. It may be necessary to do this under anesthesia. Rest in bed for two to three weeks, the administration of laxatives and the local application of heat complete the treatment. Pain persists for two and sometimes three months.

COMPLICATIONS. Patients suffering from this type of injury do not always recover under the simple regime of treatment outlined above,



FIG. 311. Anteroposterior view of coccyx, apparently negative for fracture.



FIG. 312. Same case as Figure 311, showing importance of lateral view.

FRACTURE RECORD					
Name	G. H. A.	Address	Case No.	83693	
Age	Sex	M. F.	Date	Hr.	
M. S. W. D.			Dr.		
Time of Occurrence of Accident					
Occupation STEAMFITTER, FOREMAN					
Hospital Entered					
Cause of Fracture BUMPED REGION OF BUTTOCKS AGAINST CARPENTER'S HORSE					
First Treatment					
X-Ray No.					
Final Reduction					
EXAMINATION		TREATMENT	RESULT		
Bone	COCCYX	Closed Reduction: HEAT, LAMP, SITZ BATHS	Good	Moderate	Bad
Site	TIP	Method and Position of Fixation: AND REST. NO.			
Type:	PAIN ON PRESSURE	OPERATION NECESSARY.	Anatomical		
Simple	Transverse	Anesthetic Used Yes No	Functional		
Compound	Oblique	Anatomical Result obtained			
Into Joint	Spiral				
Subluxated	Impacted				
Greenstick	Comminuted	Open Reduction			
Description of Deformity (including shortening)		Method and Position of Fixation	Description of End Result, including Disability, Shortening, Function, Pain, Swelling, Nerve		
DISLOCATION POSTERIORLY AND UPWARD, FREELY MOBILE.			(a) At discharge from Hospital Date IN 2 WEEKS		
Nature and Extent of Injury to Soft Parts (especially nerves and vessels)			(b) At discharge from O. P. D. Date		
Was non-operative treatment tried first?			(c) At subsequent date Date		
How long after injury was operation performed?			Disability: Absent, Partial, Complete		
Was internal fixation material subsequently removed?					
X-Ray	SHOWS IMPORTANCE OF LATERAL VIEW		Why	Mortality	Date
Before Reduction	VIEW		Where	Main cause of death	
After Reduction			Period of Complete Immobilization	Absence from work: Duration LOST NO TIME FROM	
At Discharge			Period of Protection	*90% of former job WORK	
Wassermann Test			Total Period of Protective Treatment	=Present Wage earning capacity	
			Compensation obtained: Yes? No?		
			Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion		

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FIG. 313. Fracture record of case shown in Figures 311 and 312.

but complain of continuous pain at the point of injury, which increases when they assume a sitting posture. This pain arises from a neuralgic condition of the coccyx, which is commonly termed "coccygodynia." When such a condition develops, the physician should insist on surgical removal of the fragments. This operation may be easily performed under a local anesthetic of 2 per cent novocaine. The fragments are removed subperiosteally, so far as is possible, and the tissues, including the muscular substance, brought together in such a manner as to close up the dead space. After operation the patient should rest in bed for at least two weeks. Recovery is complete in six to eight weeks.

Patients suffering from this injury sometimes become neurotic. In these cases merely suggesting an operation may effect a speedy cure, although sometimes only financial settlement brings about a disappearance of the neurosis; sometimes operation is the only cure.

PROGNOSIS. In these cases prognosis must be guarded. If there are no complications, the disability period is seldom longer than three months. If surgical interference is necessary, the patient is ready for work six or eight weeks after operation. In neurotic cases, no definite statement as to the length of the disability period can be made.

COMPLICATIONS FOLLOWING FRACTURES OF THE PELVIS

ORGANIC COMPLICATIONS. The complications that arise following pelvic fractures include rupture or other injury to the urethra or bladder, intestinal rupture and abdominal distention. The treatment of injuries of the urethra, bladder and intestines is not given in this volume as many readily available books can supply all necessary details.*

Abdominal distention, if treated by the application of turpentine stapes and the insertion of a high rectal tube, usually disappears within four days to a week. Peristalsis may also be induced by the administration of pituitrin or eserine, or by giving an enema composed of a pint of milk and a pint of molasses. If, however, distention persists, and the administration of morphine effects no lessening

* Young, H. H., and Waters, C. A. *Urological Roentgenology*. Hoeber, N. Y., 1928.
Stewart, H. E. *Physiotherapy*. Ed. 2. Hoeber, N. Y., 1929.

in pain and rigidity, the surgeon is justified in performing an exploratory laparotomy.*

Patients who have been treated for such complications as those mentioned above, if they go back to work which involves continuous weight-bearing, should wear some sort of binder about the pelvis, such as a Goldthwait belt or a plain canvas belt which is wide enough to include the whole pelvis and which has perineal straps, for a few months.

COMPLICATIONS DUE TO FAULTY WEIGHT-BEARING. Some patients, after the healing process is complete, complain of pain in the back, particularly in the small of the back. Such pain is often due to faulty weight-bearing. If a careful physical examination had been made at the time weight-bearing was begun, this pain could have been avoided by fitting the patient at once to the correct type of shoe. Cases of pelvic fracture nearly always show this complication and the physician should be on guard against it as soon as weight-bearing is begun.

The apparent measurement (from the umbilicus to the internal malleolus) more frequently shows a change from normal than the true measurement (from the anterior superior spine of the ilium to the internal malleolus). In addition to noting this variation by the use of the tape measure, it can be noted by having the patient stand with both feet flat on the floor and the heels and toes together. If the physician, kneeling in front of the patient, then places his thumbs on the anterior superior spinous processes he will find that his thumb on the affected side indicates a definite tilting of the pelvis in order to afford accommodation for the shortening. Accommodation is effected more easily in a child or young person than in an adult.

In order to overcome the pain caused by the shortening a built-up shoe must be worn. If the patient doubts that pain is due to shortening, he can be convinced of the fact by placing under the sole of his foot on the affected side books or magazines of varying thickness. He will note that pain is relieved when he stands on a book thick

* In very severe types of fracture, avoid morphine for a while if possible to watch the abdominal condition. If it does not clear up early and there are appearances of shock: rapid weak pulse, shallow respiration, distention, etc., it is highly advisable to operate immediately.

enough to bring the anterior superior spine of the ilium on the affected side to the level of that on the normal side.

An arthrodesis of the sacroiliac joint is sometimes performed when one side of the pelvis is much higher than the other and chronically painful, but the operation is a difficult one and should be done only by an experienced surgeon. It means disablement for nine months to a year.

CHAPTER XII

DISLOCATION OF THE HIP

DISLOCATION OF THE HIP UNACCOMPANIED BY FRACTURE

THE various forms of hip dislocation have been thoroughly treated by so many different authors that an enumeration of them in this volume is unnecessary.

SYMPTOMS. The average symptoms include gross deformity about the hip joint. The curve of the hip is accentuated and apparently much shorter than normally. There is flexion contraction of the thigh, with the knee lying slightly flexed on the other limb. Occasionally, however, the injured limb shows a decided external rotation and flexion of the knee. There are definite muscle spasm and marked pain, but crepitus is absent. Measurements from the anterior superior spine of the ilium to the internal malleolus show true shortening. Study of Nélaton's and Bryant's lines also shows the changes characteristic of hip changes. The roentgen ray is a valuable supplement to the symptoms in the diagnosis of this condition. A roentgenogram should always be made in this lesion because, particularly in the adult, one must be suspicious of a fracture complication. One can safely divide this lesion into two types, i.e., anterior and posterior dislocation.*

TREATMENT. Complete reduction of dislocation of the hip can practically never be accomplished except under complete anesthesia. A reduction is often not obtained until a number of manipulations have been tried. In some cases the surgeon must place the patient either on the floor or on the table and, standing over him, flex the patient's knee, bring the thigh to right angles and, with gentle rotation and traction, work the head of the femur back into its proper position. He is helped by an assistant who places his hand behind the head of the femur and presses upward. This method is particularly feasible in the dorsal type, or the Allis method can be used (see Cotton*). In other cases the surgeon can reduce the dis-

* It is unnecessary here to go into excessive details of symptoms as the following books, particularly that of Cotton, cover them thoroughly.

Albee, F. H. Orthopedic and Reconstructive Surgery. Saunders, Phila., 1919.

Cotton, F. J. Dislocations and Joint Fractures. Ed. 2. Saunders, Phila., 1924.

Scudder, C. L. The Treatment of Fractures. Ed. 10. Saunders, Phila., 1926.

location by hyperflexion on the abdomen, rotation of the distal extremity toward the median line, and complete abduction to an angle of 90°. Sometimes the technique used in the reduction of



FIG. 314. Obturator dislocation.

congenital hip dislocation, which follows closely the methods I have just mentioned, of hyperflexion with inward rotation and abduction of the limb, is effective. There are cases in which any of these three methods must be accompanied by traction throughout the entire manipulation, and there are other cases in which the surgeon must ingeniously combine two or more of the above-mentioned methods before the dislocation can be entirely reduced. In chronic cases an open operation at times provides the only means of reduction and is more advisable than forced closed reduction which is likely to submit the adult case to fracture.

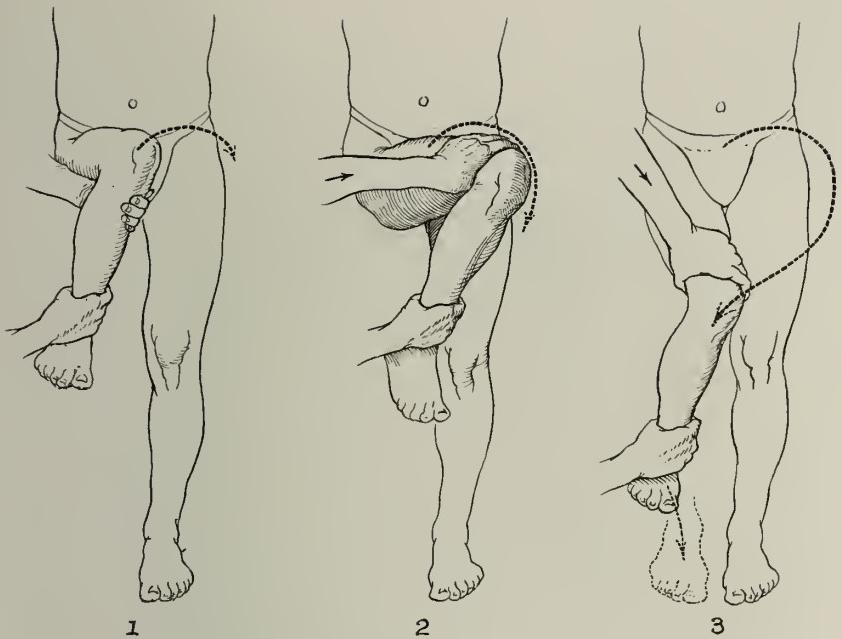


FIG. 315. Manipulation of leg in reducing dislocation of hip. (After Bigelow.)

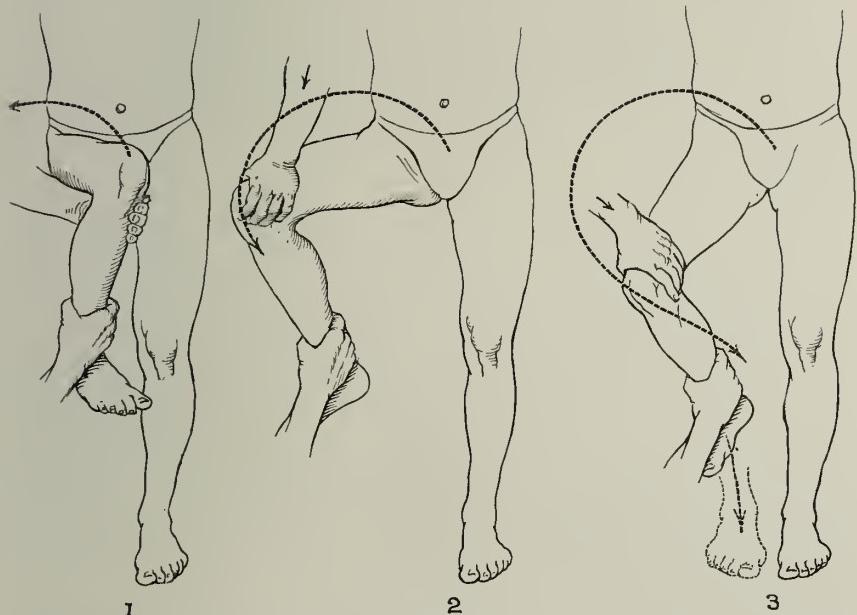


FIG. 316. Manipulation of leg in reducing posterior dislocation of hip. (After Bigelow.)

The technique for open reduction is the same as in arthroplasty of the hip: a u-shaped incision, removal of the greater trochanter, clearing out the acetabulum, being sure to make the latter conform



FIG. 317. Congenital dislocation of head of femur. Disclosures furnished by roentgenogram frustrated an attempted claim for damages. Note absence of fully formed acetabulum.

to the normal as far as possible; the same method should be used with the head of the femur, accompanied by reduction, followed by nailing the trochanter back, and closing the tissues, with the limb at an angle of 70 to 80°.

One point of importance here is that after reduction is made, great care must be exercised in maintaining original traction by the Hawley table or other suitable apparatus while applying a body-and-double-limb plaster spica. Otherwise, after or during the cast application, a redislocation may occur. It is therefore advisable to have an assistant keep up traction and maintain it before closing the wound and while applying the cast to its completion.

After the closed dislocation is reduced, the bone can best be held in place by putting the limb in the position of extension and abduc-

tion, at an angle of 70 or 80°. A Thomas splint with the tuberischial bearing and counterextension should be applied, or, if this is not available, a body cast can be used. While the splint or cast is being applied, great care should be taken to keep the limb continually in the position of extension and abduction; otherwise, the hip may again become dislocated. If the patient is placed on the Hawley table, this position can be maintained without difficulty. After the patient has returned to bed, the continuance of the position of extension keeps the articular head of the femur away from the acetabulum, and so prevents a possible contraction of the capsule; furthermore, it allows the patient to regain ultimately his former range of motion.

The limb must be kept in the position of extension with abduction with 15 lbs. pull for six or eight weeks, preferably eight. At the end of this period gentle passive and active massage with the application of heat should be begun, and continued for six or eight weeks, but not necessarily in bed. At the same time that the pain disappears, gradual weight-bearing, with the help of crutches, may be begun.

COMPLICATIONS. The presence of any systemic disease, such as syphilis, tuberculosis or rheumatism, or any focal infection, makes treatment much more difficult. Such systemic conditions should receive immediate attention. The possibility of fibrosis of the hip joint must also be considered, and this is likely to occur in cases complicated by systemic infections.

PROGNOSIS. The total disability period extends over four to six months, and, in the uncomplicated cases, should be followed by no specific loss of function.

DISLOCATION OF THE HIP ACCOMPANIED BY FRACTURE

Fracture of the pelvis accompanying dislocation of the hip has been the particular type of fracture occurring in my own experience. I have never seen a fracture of the shaft of the femur accompanying hip dislocation.

Dislocation accompanied by fracture of the pelvis is an injury very likely to occur among railroad workers, who may be caught and rolled between two cars. The fracture may involve one or both hips.

The roentgenogram is perhaps the most important factor in the exact diagnosis of these cases.

SYMPTOMS. The symptoms include immediate disability, deformity, flexion and contraction of the limb on the affected side, marked muscle spasm and pain. The patient suffers from extreme shock. Measurements show the changes from normal in the line from the anterior superior spine of the ilium to the internal malleolus and in Nélaton's and Bryant's lines. Roentgenograms are imperative.

TREATMENT. The patient should be treated immediately for shock by the administration of morphine or atropine. When shock has been controlled, one may then proceed to the treatment of the fracture and dislocation.

In cases with fracture of the pelvis any attempt at immediate reduction of the hip dislocation is usually considered carefully because of resulting injury to the bladder, urethra or abdominal viscera, or the present existence of it, precluding manipulation. When the fracture is slight, such as an involvement of one ramus with no sacroiliac disturbance, one can consider immediate reduction. Where there are multiple fractures, however, one should consider the situation thoroughly from many angles, such as increasing shock, internal hemorrhage, ruptured urethra, etc., where reduction is precluded. The pelvis must first be immobilized for about four months, with sufficient traction applied to hold the pelvis in alignment while bony union is taking place. When pelvic bony union is complete, open operation of the hip may be performed and the dislocation reduced (p. 228). The limb should then be maintained in the position of extension with abduction, at an angle of at least 70 or 80°, by means of a body cast or a Thomas splint, as described on page 211, for two and possibly three months. Great care must of course be taken to maintain traction while the splint or cast is being applied, in order that the dislocation does not recur. Another month or six weeks must elapse before weight-bearing is attempted. If the pelvis cannot be drawn down completely and subsequently upon weight-bearing there is retraction or shortening on one side, a special shoe in which the sole has been thickened by an added lift inside or outside (and in some instances where the shortening is considerable, both inside and outside) must be worn to compensate for the deformity or shortening.

COMPLICATIONS. In these cases there may occur intestinal injury, and rupture of the bladder or urethra. Any systemic infection, such

as syphilis or tuberculosis or focal infection, greatly hinders the healing process and increases the tendency to fibrosis, prolonged disability, etc.

PROGNOSIS. The disability period extends over a year or eighteen months, or longer in a case with complications. Usually the patient suffers permanently from varying degrees of loss of function, depending upon the severity of the injury or the complicating factors.

CASE OF DISLOCATION OF THE TENSOR FASCIA FEMORIS SIMULATING ORDINARY HIP JOINT DISLOCATION

This condition is very uncommon, and cannot be differentiated from ordinary hip dislocation without the use of the roentgen ray. It is usually produced by a sudden inward twisting of the femur while lifting a heavy weight. The photographs and drawings taken in this case were of a nurse who contracted the affection while trying to lift and to change the position of a heavy patient in bed. The case was considered by the two physicians who saw her first as being a dislocation, so, without the roentgen rays, an attempt at reduction was unsuccessfully made. Upon being called in I had roentgenograms made, which showed the head in situ, but a definitely stretched band of fascia over the outer side of the greater trochanter, with the affected trochanter much more prominent than the other.

SYMPTOMS. The appearance of the limb was identical with that of a dorsal hip dislocation, with inward rotation of the limb, the knee flexed and drawn up. There were marked deformity over the curve of the hip, definite spasm, restricted motion and no crepitus. This picture, however, as seen would alone signify a dislocation, so for that reason a roentgenogram is imperative to complete one's diagnosis.

TREATMENT. When recognized early, within the first week, it may be possible to reduce under general anesthesia, the same technique being followed as in that of ordinary dorsal hip dislocation, which is hyperflexion of the thigh and knee on the abdomen, rotation of the limb with foot facing median line, then abduction of the hip while the limb is in this position. If reduced, the limb when placed on the table will take the same position as the other, in which event place the limb in *full* abduction, to allow contraction of the



FIG. 318. Dislocation simulated by slipping of tensor fascia femoris over greater trochanter.



FIG. 319.



FIG. 320.

FIGS. 319 and 320. Same case as Figure 318. Line of approach in case operated upon.
Lateral and anteroposterior views.

FRACTURE RECORD							
Name	MISS K.	Address	Case No.	59395			
Age	Sex	M. F.	M. S. W. D.	Date	Hr.		
Occupation	NURSE		White or Colored	Dr.			
Cause of Fracture	TURNED BODY SHARPLY IN WALKING.			Time of Occurrence of Accident	4-5-25 FIRST SEEN IN		
				Hospital Entered	CONSULTATION WITH DR. GALLO-		
				First Treatment	HIP 1 YR. PRIOR. SIMILAR		
				Final Reduction	ACCIDENT A FEW DAYS BEFORE		
X-Ray No.				SEEN	RESULT		
EXAMINATION		TREATMENT		Good	Moderate	Bad	
BONE LEG LOCKED IN POSITION POSTERIOR DIS- LOCATED HIP. PRIOR UNSUCCESSFUL AT- TEMPTS TO REDUCE "DISLOCATION."		Closed Reduction		Anatomical Functional			
Simple Transverse		Anesthetic Used	Yes	No	Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve		
Compressed Oblique		Anatomical Result obtained		(a) At discharge from Hospital Date 6-11-25. NO			
Intertubular Sagittal				LIMITATION IN HIP MOTION, NO PAIN, NO			
Subluxated Translated				APPARENT FUNC. LIM. IN USE OF LEG.			
Greenstick Comminuted		Open Reduction ETHER ANESTHESIA. INVERTED Method and Position of Incision J-SHAPE INCISION					
Description of Deformity including shortening		OVER GREAT R TROCHANTER. FASCIA SHOWED A TEAR THROUGH ITS FIBERS SOMEWHAT ANT. WHICH ALLOWED GREATER TROCHANTER TO SLIP THROUGH AND FIX FEMUR.		(b) At discharge from O. P. D. Date 6-21-25 SEEN AND PHOTOGRAPHED. NO FURTHER LOCKING OF HIP. NO. LIM. IN MOTION OR LOSS OF FUNCTION OF LEG.			
Nature and Extent of Injury to Soft Parts especially nerves and vessels		DEFECT IN FASCIA CLOSED WITH KANGAROO TENDON. SHORT STICA APPLIED.		(c) At subsequent date Date			
				Disability: Absent, Partial, Complete			
		How long after injury was operation performed?					
		Was internal fixation material subsequently removed?					
X-Ray SHOWED NORMAL RELATIONS IN HIP.		Why		Mortality	Date		
Before Reduction				Male case of death			
After Reduction		Period of Complete Immobilization		Absence from work:	Duration		
At Discharge		Period of Protection		*Ability to resume job			
Wassermann Test		Total Period of Protective Treatment		*Present Wage earning capacity			
				Compensation obtained: Yes? No?			
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion			

Form 19, U. S. Life Insurance System
Published Courtesy, Dr. Charles H. Mayo

FIG. 321. Fracture record of case shown in Figures 318-320.

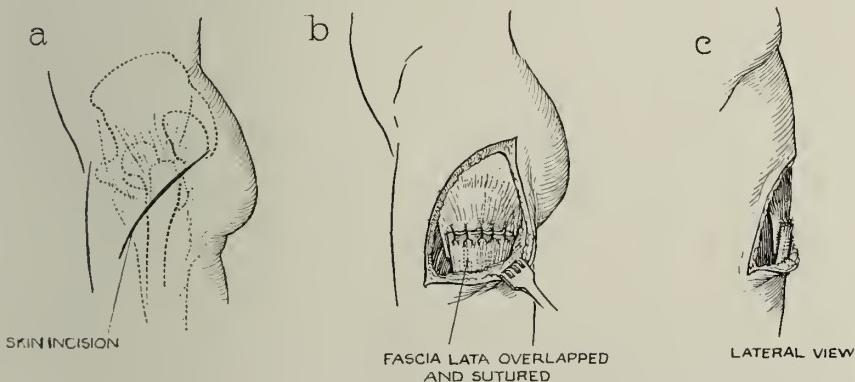


FIG. 322. Surgical repair of chronic dislocation of tensor fascia femoris.

fascia, place in body spica for six to eight weeks and follow by gradual massage and weight-bearing.

In this condition it is always advisable to explain to the patient the possibility of the failure of reduction by the closed method and to obtain permission to operate. The operative technique is as follows:

A transverse incision is made in the tensor fascia femoris, as shown in Figure 322, cutting clear through the structure, then, after abducting the limb to about 60 to 70°, overlapping the fascia to plicate it.

Leave the limb in abduction and apply a plaster body spica. Leave this on for five to six weeks, and after removing, institute gentle massage, gradual use of the limb in bed for two weeks, then gradual weight-bearing.

COMPLICATIONS. Complications will be an occasional inability to obtain closed reduction, particularly when of long standing, in which event an open operation is the only choice. In that case an incision, as shown in Figure 322, is logical.

PROGNOSIS. Disability will be temporary, totaling eight to twelve weeks, with no specific loss.

CHAPTER XIII

INJURIES OF THE FEMUR

INTRACAPSULAR FRACTURES OF THE HEAD OF THE FEMUR

INTRACAPSULAR fractures of the head of the femur usually occur in people of advanced age, although they are not uncommon in younger individuals whose work subjects them to the possibility of rolling or crushing injuries. Such a fracture is also the result of a direct fall.

SYMPTOMS. The injury is characterized by marked pain on pressure at the site of the fracture or occasionally in the knee joint. When the neck of the femur is impacted without causing much distortion, pain is very often present only in the knee joint. No physician should allow himself to be misled by this symptom. If roentgenograms show a negative condition of the knee, and the patient continues to complain of knee pain, the physician should always make roentgenograms of the hip, in order to discover whether there is an intracapsular fracture of the head of the femur. I have one case on record where this was definitely shown.

There are present muscle spasm and rigidity; usually no crepitus. The patient is unable to bear weight on the affected side but he may give a history of attempts to walk directly after the accident. There is deformity of the entire limb, the leg usually being fixed in a position of increased flexion and inward rotation, although the reverse may be the case—marked external rotation of the leg. Measurement from the anterior superior spine of the ilium to the internal malleolus shows shortening. The roentgen ray, *if the details are clear*, is an indispensable supplement to these symptoms in the establishment of the diagnosis. When impaction is slight both hips should be roentgenographed for comparison.

TREATMENT. Extreme caution is necessary in the treatment of this injury, a fact which many physicians fail to recognize.

Cases with a History of Weight-bearing Following the Accident. The surgeon should first of all inquire whether weight-bearing was attempted after the accident. If this was the case, the surgeon must assume that the fragments, which in this injury are generally

impacted, have become separated or partially so. (Separation of the fragments, causing greater deformity, may also occur in cases of severe fracture without a history of weight-bearing and requires the same treatment as separation caused by weight-bearing.) If the roentgen ray confirms this assumption, the patient, provided senile changes do not make treatment impossible (see p. 240), must be placed in bed, a Buck's extension applied with abduction and the deformity reduced even if it means a complete breaking up of the impaction. The limb must be kept in a position which is conducive to normal alignment of the fragments, for a week or ten days. In regard to the question of alignment the easiest way to accomplish it is to place the limb in the same position as the normal. This cannot be done where there is an impaction without breaking up the impaction. Of course the matter of breaking up the impaction must be controlled by the age, physical infirmities, general nutrition and build in the individual case. In patients over forty to forty-five years of age the question of breaking up an impaction should be carefully considered. When an artificial impaction can be used we proceed as follows:

Under general anesthesia, the Cotton impaction closed operation (Fig. 323) should next be performed. This operation is done with the limb in full abduction and extension with some internal rotation. In fact before impacting, a true measurement from the anterior superior spine of the ilium to the internal malleolus can be taken to assist in deciding as to the necessity for further traction. Four or five forcible blows over the trochanter are not too many. After operation a cast consisting of body spica including both limbs should be applied and kept on for three months. In doing this a Hawley table or strong physical traction should be used and the cast applied with the limb still under traction. A walking caliper (see Fig. 324) should be used for another three months at least before weight-bearing is attempted.

In applying a walking caliper great care should be exercised in seeing that the ring fits snugly against the tuber ischii. An assistant applies the shoe, inserts the side bars of the caliper in the shoe, then uses traction while the surgeon holds the ring against the tuber ischii. When this is carefully adjusted, the surgeon fastens the set screws.

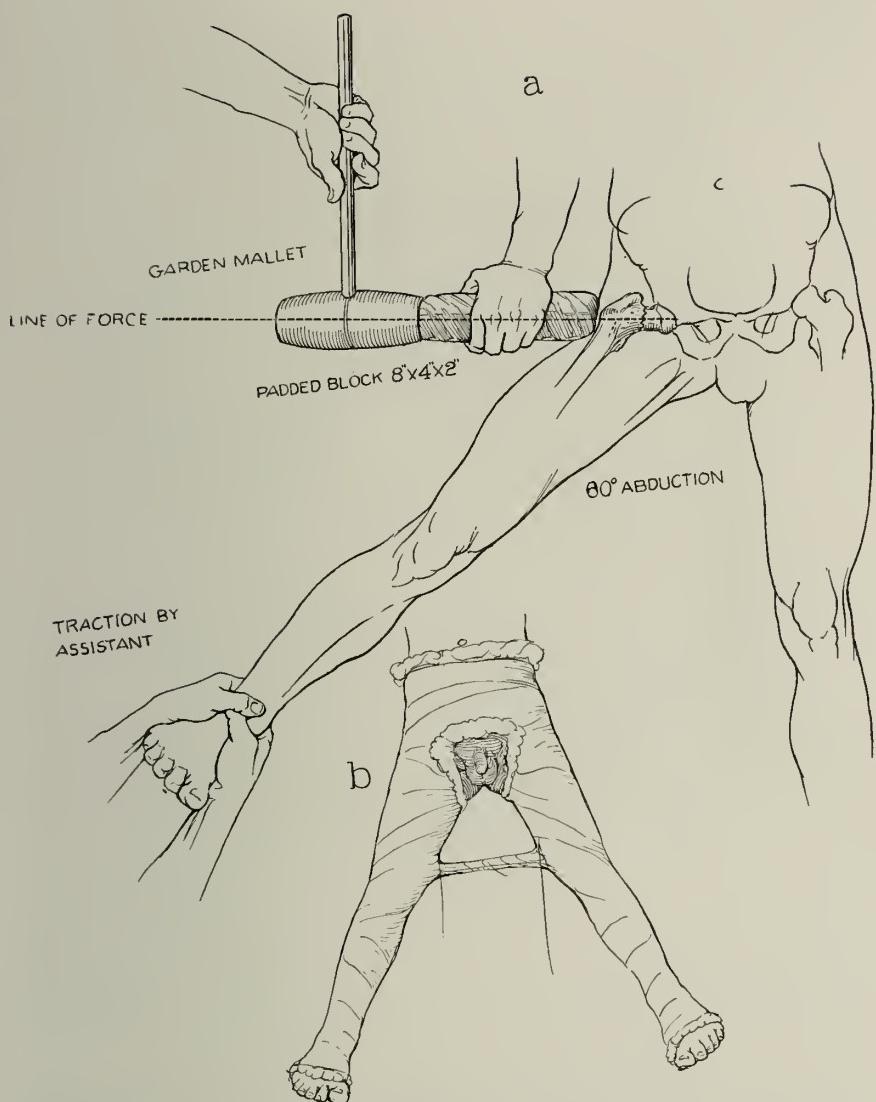


FIG. 323. Impaction method of striking with mallet. Abduction of 60° to 80° , depending on amount of absorption of neck, with traction.

In this way one can be sure that the weight borne is on the splint and not on the leg.

If the operation is delayed too long, absorption of the impacted

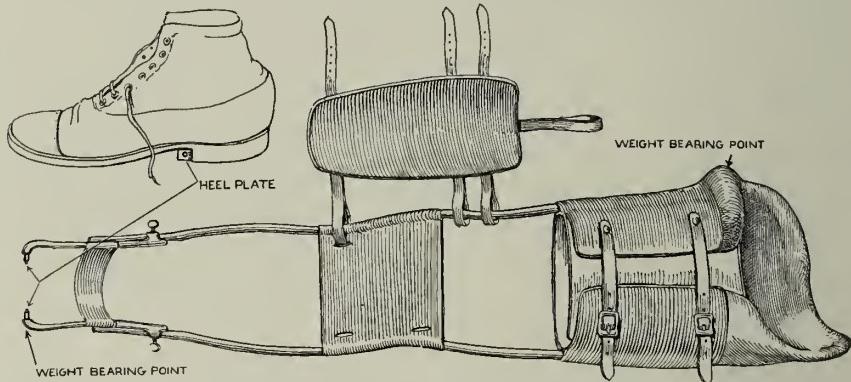


FIG. 324. Walking caliper with tuberischial bearing. Note set screws for adjustment. This form of caliper can also be used with ordinary Thomas ring instead of bucket. This is a Critchley bucket.

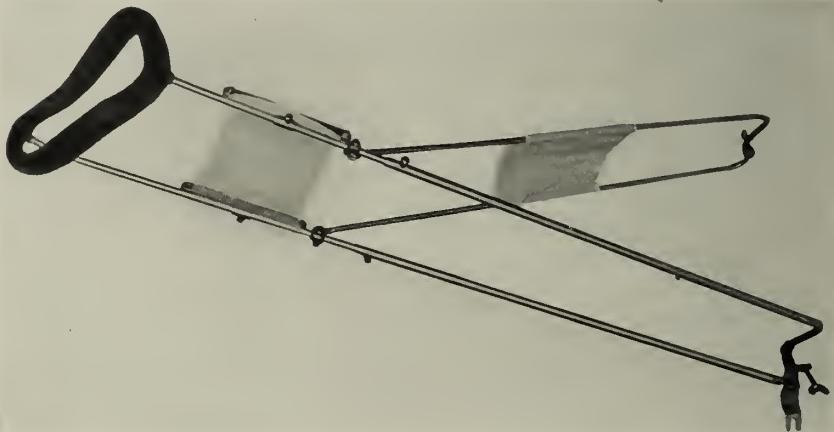


FIG. 325. Splint used when Steinman pin or calipers are introduced in femur fractures, permitting early knee joint action. Particular value of this splint lies in correct molding of perineal ring. (From a model by Critchley.)

neck of the femur may take place, and if this occurs the Cotton impaction method cannot be followed. An open operation such as Albee's* must then be performed in which the surgeon does whatever he can to obtain the greatest ultimate degree of function in the injured

*Albee, F. H. Orthopedic and Reconstructive Surgery. Saunders, Phila., 1919.

limb. This operation is followed by nine months to a year of disability and the patient may suffer some degree of permanent disability. To be sure, I have performed the Cotton impaction operation three months after the date of the accident and obtained excellent results. I have even gone so far, in a number of early cases, as to break up a fresh impaction, where the limb was badly deformed, reduce the deformity and at the end of ten days to two weeks of traction forcibly reimpact the limb in a position of abduction at an angle of 60° to 80°; and, after the application of a body cast for three months and a tuberischial weight-bearing caliper for another three months, I have obtained successful results. Generally speaking, however, the Cotton impaction operation should be performed as soon as possible after the accident. If this is done and if early weight-bearing is strictly avoided, there will be fewer cripples and the disability period will be materially shortened.

I have one patient under my care who was treated by another physician in the following manner: Directly after the accident a cast was applied and left on for five weeks. He was then put in a wheelchair for a week, after which he was told to use crutches and to bear weight on the fractured leg. Today he has an ununited fracture. As the neck has become absorbed, I can do nothing for him but perform an open operation. Such a case strongly emphasizes the danger of applying an immobilization cast or splint for five or six weeks only, and then allowing the patient to begin weight-bearing. Such treatment can only result disastrously.

Cases without a History of Weight-bearing Following the Accident. In cases in which there is no history of weight-bearing following the accident, and in which the roentgenogram confirms the assumption that the impaction is not broken up, the injury, in patients of fifty years or more, should be treated simply by placing sandbags about the injured hip and leg for a period of three months, and *avoiding all traction.*

The reason I call attention to avoiding traction in these cases, is that (1) there is no occasion for it; (2) injudicious use of traction will separate these impactions in some cases. I have seen this done a number of times when a bad case was being dealt with.

At the end of three months the patient may get out of bed but must wear a walking caliper (see Fig. 324). In younger patients a

body cast, with the leg in the position of full abduction without force, should be applied and allowed to remain on for at least sixty and preferably ninety days. I am inclined to tend toward conservatism in this repeat, and prefer ninety days. If the cast is removed at the end of sixty days, I keep the patient in bed another thirty days. At the end of that time it may be removed and a walking caliper applied and allowed to remain on ninety days before any direct weight-bearing is attempted.

In a patient of advanced years, various possible complications necessitate simpler treatment of the fracture, even in cases in which the fragments are separated. Passive and active lung congestion and pneumonia are ever-present dangers. For this reason the physician may wish to keep the patient in Fowler's position as much as possible. In men of advanced years the possibility of prostatic complications must be kept in mind. In aged and thin patients pressure necrosis is a complication which may follow the application of a light splint, with or without traction, to the fractured leg.

Senile changes may in some cases bring about complications which necessitate getting the patient out of bed shortly after the accident. In such cases a light walking caliper made of aluminum may be applied, if the patient is strong enough to wear one. If not, he must move about only with the help of crutches. It is better that the patient suffer an ununited fracture than become subject to the complications that may follow long-continued treatment in bed and possibly death.

The Walking Caliper. This consists of a Thomas ring, properly molded to the perineum, which throws the weight on to the tuber ischii, the side bars coming down and fitting into the heel of the shoe (see Fig. 326). These bars should be made so that they will slide one inside of the other, with a set screw on each one. The physician must be quite sure that the weight is being put on the caliper instead of on the limb (when the ring is held tightly up against the perineum). The other section of the caliper is in the shoe. He must also see that the proper degree of counterextension is produced and that the appliance is locked in the desired position.

PROGNOSIS. The period of disability extends over nine months to a year at least in uncomplicated cases. Great care should be taken in estimating the length of this period, since the possibility of bone



FIG. 326. Thomas ring walking caliper.
(From a model by Critchley.)



FIG. 327. Perineal caliper crutch
with bucket fitted accurately for
weight-bearing. (From a model by
Critchley.)



FIG. 328.



FIG. 329.

FIGS. 328 and 329. Walking caliper used on fractured femur. Note particularly curve and angle of ring.



FIG. 330. Result of Cotton impaction at end of thirteen months. See chart (Fig. 331).

FRACTURE RECORD					
Name	T.W.	Address	5116 PRINCETON AVENUE		
Age	32	Sex	M	M. S. W-B	White or Colored
Occupation	LABORER				Time: Occurrence of Accident
Cause of Fracture	FELL, ONE STORY ABOUT FIFTEEN FEET			Hospital Entered	WEST SIDE
				First Treatment	6-19-25
				X-Ray No.	25963
EXAMINATION		TREATMENT		RESULT	
Bone	LEFT FEMUR	Closed Reduction		Anatomical	Good Moderate Bad
Site	KNEE	Method and Position of Friction		COTTON IMPACTION	
Type:	"	Anesthetic Used		Yes	No
Simple	Transverse	Anatomical Result obtained		GOOD	
Compound	Oblique			(a) At discharge from Hospital Date 9-10-25	
Intra-articular	Spiral			1 INCH SHORTENING. GOOD UNION AND	
Subarticular	I Impacted			NO DEFORMITY	
Greenstick	Comminuted	Open Reduction			
		Method and Position of Friction			
Description of Deformity including shortening					
IMPACTED FRACTURE AT NECK OF LEFT FEMUR					
WITH 1 INCH SHORTENING					
Anatomical Result obtained					
GOOD UNION					
GOOD FUNCTION					
Nature and Extent of Injury to Soft Parts					
DISCOLORATION, SWELLING AND BRUISES					
Was non-operative treatment tried first?					
How long after injury was operation performed?					
Was internal fixation material subsequently removed?					
X-Ray	Why	Morbidity		Date	
Before Reduction	POSITION POOR	When		Main cause of death	
After Reduction	POSITION GOOD	Period of Complete Immobilization		Absence from work: Duration	
All Discharge	GOOD ALIGNMENT	5 MONTHS		1 YEAR	
Wassermann Test	NEGATIVE	Period of Protection		*Ability to resume job YES	
		4½ MONTHS		*Present Wage earning capacity SAME	
		5 MONTHS		Compensation obtained: Yes? NO?	
Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion					

Form 191 A.C.S. Case Record System
F&D Form Company, Chicago

FIG. 331. Fracture record of case shown in Figure 330.



FIG. 332.



FIG. 333.

Figs. 332 and 333. Results of Cotton impaction at end of four and eight months, respectively.

FRACTURE RECORD

Name	T.E.F.	Address	6345 NORMAL AVENUE	Case No.	52630
Age	58	Sex	M F	Date	1-7-25
Occupation	PAINTER	M. S. W. D.	White or Colored	Dr.	10:30 A.M.
Cause of Fracture	fell distance of twelve feet			Hospital Entered	
				First Treatment	
			X-Ray No.	Final Reduction	
EXAMINATION		TREATMENT		RESULT	
Bone	LEFT FEMUR	Closed Reduction COTTON'S IMPACTION OPERATION		Good	Moderate
Site		Method and Position of Fixation	EXTREME ABDUCTION		Bad
Type	ANATOMICAL NECK	OF LEG IN PLASTER CAST.			
Simple	Transverse	Anesthetic Used	Yes No		
Compound	Oblique	Anatomical Result obtained FIRM IMPACTION			
Into Joint	Spiral	BY USE HAMMER PRESSURE ON TROCHANTER.			
Subperiosteal	<input checked="" type="checkbox"/> Imbedded				
Greenstick	Comminuted	Open Reduction			
		Method and Position of Fixation			
Description of Deformity including shortening				(a) At discharge from Hospital Date	1-26-25
THREE-FOURTHS INCH SHORTENING				IN CAST	
		Anatomical Result obtained			
Nature and Extent of Injury to Soft Parts especially nerves and vessels				(b) At discharge from P. D. O. Date	8-27-26
		Was non-operative treatment tried first?		THREE-FOURTHS INCH SHORTENING	
		How long after injury was operation performed?		ONE & THREE-FOURTHS ATROPHY OF THIGH	
		Was internal fixation material subsequently removed?		ROTATION AT HIP 50°	
		Why		FLEXION BEYOND RIGHT ANGLE	
X-Ray				(c) At reexamination date Date	
Before Reduction		FRACT. NECK FEMUR. SL. IMPACTION		Disability: Absent. Partial. Complete. 75% OF LEG	
After Reduction		FRACTURE WELL IMPACTED		Main cause of death	
At Discharge		FIRM UNION. NECK ABSORBED.		Absence from work: Duration 14 MONTHS APPROXIMATELY	
Wassermann Test		NEGATIVE.		*Ability to resume job	
				*Present Wage earning capacity	
				Compensation obtained: Yes? No?	
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 19 (U. S. Government Printing Office)

FIG. 334. Fracture record of case shown in Figures 332 and 333.



FIG. 335. Results of Cotton impaction at end of nineteen months. Patient walking without cane or crutch, using prosthetic shoc.

FRACTURE RECORD					
Name	R. W.	Address	3312 S. WOOD STREET	Case No.	62800
Age	34	Sex	M R	Date	8-4-25-H.
Occupation	CEMENT FINISHER			Dr.	FORRESTER
Cause of Fracture	SCAFFOLD PLATE BROKE AND HE FELL TWO STORIES				
			X-Ray No.	28287	
EXAMINATION			TREATMENT		
Bone	FEMUR - RIGHT		Closed Reduction		
Site	LOWER PORTION ANATOMICAL NECK		Method and Position of Fixation	COTTON IMPACTION	
Type			WITH USE OF BODY CAST		
Simple	Transverse		Anesthetic Used	Yes #	
Compound	Oblique		Anatomical Result obtained	GOOD	
Taste Test	Normal				
Palpated	X Impacted				
Grooved	Compressed		Open Reduction		
			Method and Position of Fixation		
Description of Deformity including shortening					
NO DISPLACEMENT OF FRAGMENTS					
Nature and Extent of Injury to Soft Parts <small>especially nerves and vessels</small>					
NONE			Was non-operative treatment tried first?	No	
			How long after injury was operation performed?		
			Was internal fixation material subsequently removed?		
X-Ray FRACTURE OF LOWER PORTION OF ANATOMICAL NECK OF R. FEMUR			Why	Mortality	
Before Reduction			When	Date of death	
After Reduction FIBROUS UNION AT FIRST ATTEMPT			Period of Complete Immobilization	Absence from work: Duration	
At Discharge			Period of Protection	*Ability to resume job	
Wassermann Test NEGATIVE			Total Period of Protective Treatment	*Present Wage earning capacity	
				Correspondence obtained: Yes? No?	
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 194-L.C. Case Report, by name
For Intern Consideration, Chicago

FIG. 336. Fracture record of case shown in Figure 335.

absorption, of non-union and of other complications due for example to senile conditions, must be considered. These patients always suffer loss of function, even in the most successfully treated instances, because impaction is certain to result in a shortening of the long axis of the neck of the femur, which in turn causes a shortening of the entire shaft. The length of shortening is at least $\frac{3}{8}$ to $\frac{1}{2}$ an inch and sometimes more, but can be compensated for later by the use of an orthopedic shoe. These patients will also have difficulty in flexing the limb upon the abdomen and will notice difficulty in stooping and in putting on their clothes and shoes.

In cases of non-union of the neck of the femur, when a roentgenogram is not obtainable, and even when it is used, a very practical examination can be made to determine non-union, as the accompanying drawing will show (Fig. 337).

FRACTURES OF THE LESSER TROCHANTER

SYMPTOMS. Following this injury any attempt to abduct or adduct the limb causes pain. Pain is marked on external and internal rotation and there is localized pain on pressure over the lesser trochanter. Fixed adduction is the most comfortable position. Sandbags usually suffice. There is muscle spasm, but crepitation is difficult to demonstrate. Measurements are of no value as a supplement to the symptoms in the making of a diagnosis but roentgenograms are very important.

TREATMENT. Adduction of the thigh in order to take the muscular pull off the structures is essential. The patient should lie in bed for six to eight weeks with the limb on the affected side held toward the median line or even a little beyond the median line toward the other side of the body. No form of appliance is necessary. Massage and heat may be applied and at the end of eight weeks weight-bearing may be attempted. The roentgen ray is a valuable guide in estimating the rate of callus formation. Occasionally fracture of the lesser trochanter does not heal by bony union but this prominence becomes encapsulated and forms a fibrous union. This type of healing does not constitute a permanently disabling feature.

PROGNOSIS. The disability period extends over three to four and a half months. It may be as long as five months in those cases which heal by encapsulation of the lesser trochanter in muscle substance.

FRACTURES OF THE GREATER TROCHANTER

SYMPTOMS. The symptoms of this type of fracture include pain and muscle spasm which are especially noticeable on adduction and on abduction with rotation. Voluntary abduction with external rotation is practically impossible because of pain and loss of muscle balance. There is not, however, complete loss of hip joint motion and the patient can sometimes walk with difficulty. There is some swelling and a change in contour over the outer side of the thigh, the space between the crest of the ilium and the head of the trochanter being markedly decreased over normal. Occasionally there is crepitation. Although Nélaton's and Bryant's lines show changes, since the trochanter lies higher, being drawn up by muscular spasm, other measurements are of no value except to eliminate various other types of fracture, such as intracapsular and intertrochanteric or surgical neck. The roentgenograms show a drawing away of the fragment or fragments from the parent structure.

TREATMENT. Treatment consists of hyperabduction with external rotation. From the point of fracture down, the limb should be abducted as far as possible, 80° or more, for a period of ten to twelve weeks. Contraction of the muscles which normally abduct the limb, or assist in abducting or rotating it, separates the fragments, so that in resorting to hyperabduction of the limb the physician brings the shaft out to meet the deformity produced by this contraction.

The physician should observe this form of injury carefully during the early process of treatment, by the comparison of a number of roentgenograms, in order to determine whether the separated portion is brought into position by means of hyperabduction. Sometimes it is not brought into contact, in which event it is advisable to perform an open operation, exposing the large fragment and holding it in its relative position by mechanical means. The former method, however, will, as a rule, suffice.

Technique of Operation. The Murphy method of approach is the best for this operation. This consists of a U-shaped incision over the greater trochanter, which gives a complete exposure of the fracture and shows the extent of the displacement. One or two holes are then drilled through the fractured fragment and through the parent structure, the fragment being replaced in its proper position and secured by means of kangaroo tendon, or nailing or wiring.

After the operation is performed, the limb should be maintained in hyperabduction, and a body cast or Thomas splint applied (preferably a cast for this type) without traction, while an assistant maintains full abduction with slight external rotation. This cast or splint should be left on for at least six or eight weeks, depending upon the rapidity of bony union. At the end of this period passive and active massage should be resorted to, and in ten to twelve weeks weight-bearing can be begun.

Other materials besides kangaroo tendon may be used to attach the fragment to the parent structure; for example, screws, exogenous and autogenous bone grafts, wire nails, etc. Personally I have an aversion to introducing foreign material if it can possibly be avoided, because too often such material acts as a foreign body, irritating the surrounding structures and producing bone necrosis and osteomyelitis, conditions which require subsequent operation and further disability.

PROGNOSIS. At least two and one-half to three months must pass before weight-bearing is attempted. Total disability extends over four or five months with no specific loss of function after treatment.

COMPLETE FRACTURES THROUGH THE INTERTROCHANTERIC LINE

This type of fracture, which is far from uncommon in traumatic surgery or industrial cases, if treated by a physician who applies the principles of muscle balance, should result in perfect union without any permanent loss of function. Too often, however, the principles of muscle balance are not sufficiently considered. This fracture is almost always a comminuted one, with considerable breaking up of the bone. The short fragment abducts and rotates externally, a condition which is caused by the strong muscular attachments pulling the fragment outward and backward. In addition, the heavy adductor muscles pull the shaft of the femur to the medial line. Since the muscles, then, play so important a rôle, study in muscle balance is very necessary to successful treatment.

SYMPTOMS. This injury is characterized by immediate disability, pain, muscle spasm, deformity and occasionally crepitus. There is usually external rotation of the distal extremity. Shortening is noticeable along the line marking the true length of the hip (from the anterior superior spine of the ilium to the internal malleolus).

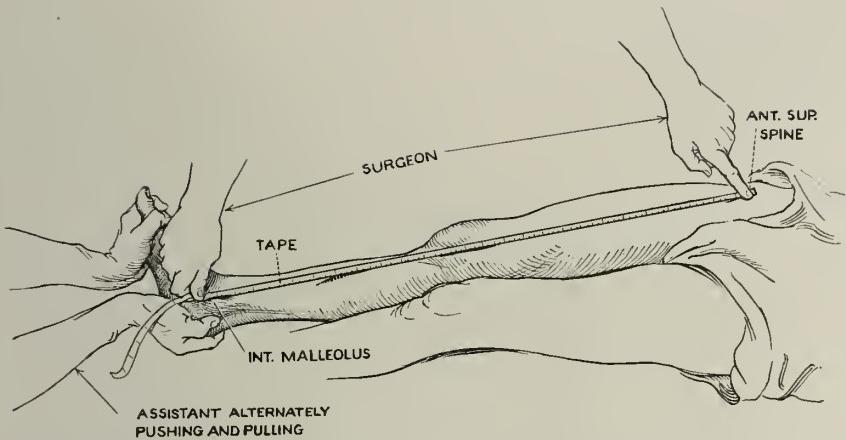


FIG. 337. Method of determining union or non-union of intracapsular fracture of femur with or without roentgenogram.

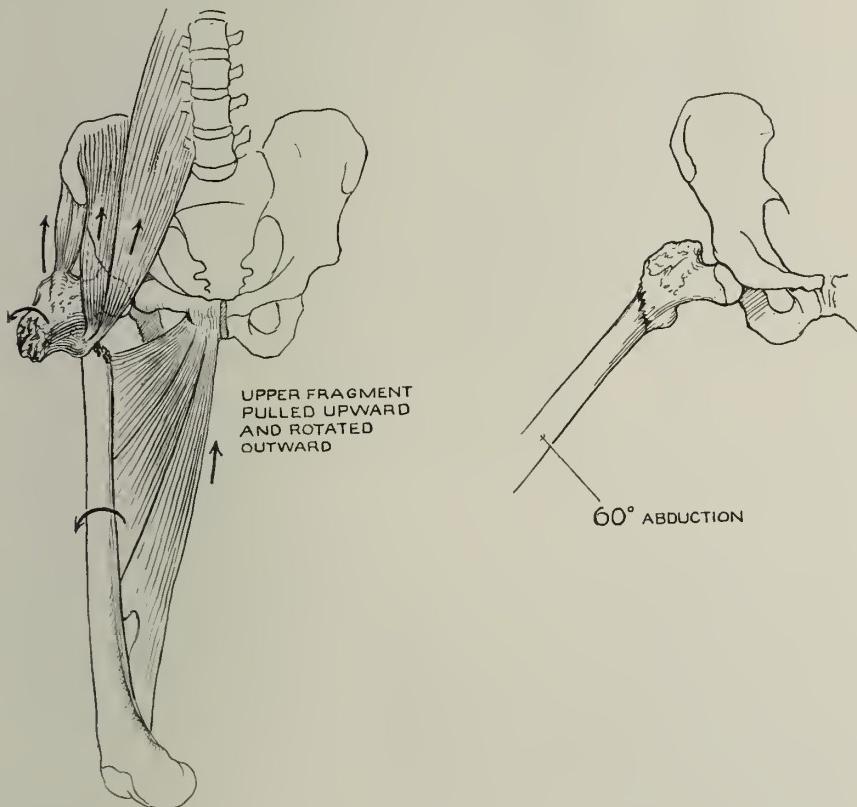


FIG. 338. Distortion produced by muscle pull in fractures of surgical neck and intertrochanteric fractures.

Roentgenograms are excellent supplements to these symptoms in the making of a diagnosis.

TREATMENT. Injuries of this type, as mentioned above, should be



FIG. 339. End-result of a long spiral fracture of femur through and slightly below the intertrochanteric line, using closed method of Thomas splint with abduction and traction. (See chart, Fig. 340.)

treated only by a physician who has familiarized himself with the principles of muscle balance. Since it is impossible, because of the pull of the heavy muscles attached to the proximal fragment, to pull the short fragment down in a straight line, approximation must be effected by abducting the distal end. This should be done by allowing the patient to lie quietly in bed for a week or ten days, where shock is great, with sand bags about the injured leg and a Buck's extension applied to the leg. A Thomas splint with a Buck's extension may then be easily applied without the use of an anes-

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thetic. A weight of 20 to 30 lbs. should be used with skin traction and the limb should be abducted at an angle of 60° or 80° , or more, if possible. If skeletal traction such as a Steinman pin is used, 15

FRACTURE RECORD					
Name	F.H.	Address	704 EAST 40th STREET	Case No.	61513
Age	35	Sex	M ♂	Date	7-13-25
Occupation	LABORER			Hospital Entered	AMERICAN
Cause of Fracture	WRECKING WALL COLLAPSED AND HE FELL 20 FEET			First Treatment	7-13-25
			X-Ray No	25034	Final Reduction
EXAMINATION			TREATMENT		
Bone	LEFT FEMUR	Closed Reduction			
Site	DFFER 1/3	Method and Position of Fixation			
Type:		THOMAS SPLINT AND TRACTION			
Scars	Transverse	Anesthetic Used	X	No	
Compound	Oblique	Anatomical Result obtained	GOOD ANATOMICAL		
Trauma Joint	Sobal	POSITION	▲		
Subluxated	Impacted				
Groinick	X Comminuted	Open Reduction			
Description of Deformity including shortening			Method and Position of Fixation		
ABOUT 2 INCHES SHORTENING.			(a) At discharge from Hospital Date 9-1-25		
NO VISIBLE DEFORMITY, ONLY BY X-RAY.			NO DEFORMITY.		
			PAIN LEFT THIGH		
			NO SHORTENING		
Nature and Extent of Injury to Soft Parts			Description of End Result, including Deformity, Shortening, Function, Pain, Seeding Nerve.		
Bruises and contusions of left thigh			(a) At discharge from O.P.D. Date 2-2-26		
Was non-operative treatment tried first?			NO SHORTENING.		
How long after injury was operation performed?			SLIGHT PAIN ON WALKING.		
Was internal fixation material subsequently removed?			FUNCTION COMPLETE.		
X-Ray			NO DEFORMITY.		
Before Reduction			NO DEFORMITY.		
After Reduction			Disability: <input checked="" type="checkbox"/> Partly, <input type="checkbox"/> Complete 8 MONTHS		
At Discharge			Mortality Date		
Walsermann Test			Main cause of death		
OVERRIDING FRAGMENTS			Absence from work: Duration 8 MONTHS		
GOOD ALIGNMENT			Ability to resume job YES		
GOOD CALLUS AND ALIGNMENT			Present Wage earning capacity SAME		
NEGATIVE			Compensation obtained: Yes? NO?		
			Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion		

Form 194, C. S. Case Record System
Revised Completely, October

FIG. 340. Fracture record of case shown in Figure 339.

lbs. weight will suffice if the limb is kept at the proper abduction. The limb is thus brought out to meet the deformity produced by the contraction of the muscles on the short fragment, the deformity practically reduces itself and the bones fall into alignment, provided that the abduction and traction are accompanied by a certain amount of external rotation of the limb. Abduction and traction should be continued for eight to twelve weeks. Fortunately union takes place rapidly in this form of fracture, as contrasted with the slow and doubtful union of fractures of the intracapsular type.

At this time I wish to emphasize the point that in any form of traction where a Buck's extension is used, the physician should pay close attention to the building up of the popliteal space at the knee. Placing the knee in a position of 10 to 15° flexion and padding it



FIG. 341.

FIG. 341. Intertrochanteric fracture with adduction deformity, before reduction.
FIG. 342. Same type of fracture as Figure 341 after reduction by abduction. Fracture of lesser trochanter also shown.



FIG. 342.



FIG. 343. Roentgenogram taken four months after abduction treatment with traction of badly comminuted fracture of surgical neck of femur.

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prevents the stretching of the posterior ligaments of the knee joint caused by the steady pull of the Buck's extension. If this precaution is not observed, the patient will suffer from genu recurvatum accom-

FRACTURE RECORD					
Name	F.M.T.	Address	MONTICELLO, IND.		
Age	52	Sex	M. R.	M. S. W-D	White or Colored
Occupation	IRON WORKER			Time: Occurrence of Accident 10-7-25	
Cause of Fracture	STRUCK BY SWINGING BEAM			Hospital Entered WEST SIDE	
				First Treatment 10-7-25	
				Final Reduction	
X-Ray No.	26294				
EXAMINATION	TREATMENT			RESULT	
	Closed Reduction	Anatomical	Functional	Good	Moderate
Bone LEFT FEMUR	Method and Position of Fixation				
Site UPPER 1/3	THOMAS SPLINT WITH TRACTION				
Type:	Anesthetic Used Yes No				
Spiral Transverse	Anatomical Result obtained FAIRLY GOOD ALIGNMENT				
Compressed Oblique	OF THE COMMUNICATED BONES				
Into Joint Apical				(a) At discharge from Hospital Date 12-9-25	
Subperiosteal Injected				WALKS WITH AID OF CRUTCHES.	
Greenstick X Comminuted	Open Reduction			NO WEIGHT BEARING, 1/2 INCH SHORTENING.	
Description of Deformity including shortening	Method and Position of Fixation				
ANGULAR DEFORMITY WITH 2 INCHES SHORTENING.				(b) At discharge from O.P.D. Date 4-8-26	
SOFT TISSUES OVER FRACTURE				NO DEFORMITY, 1/2 INCH SHORTENING.	
Nature and Extent of Injury to Soft Parts especially nerves and vessels	Anatomical Result obtained			RESTRICTION OF ABDUCTION AND COMPLETE FLEXION	
TRAUMATISM, CONFUSION AND BRUISES OF SOFT TISSUES OVER FRACTURE					
Before Reduction OVERRIDING FRAGMENTS	When			(c) At subsequent date Date	
After Reduction SLIGHT EXTERNAL DISPLACEMENT	Period of Complete Immobilization 8 WEEKS			Disability: Absent, Partial, Complete 7 MONTHS	
At Discharge GOOD CALLUS	Period of Protection 44 MONTHS			Absence from work: Duration 7 MONTHS	
Wassermann Test NEGATIVE	Total Period of Protective Treatment 44 MONTHS			*Ability to resume job YES	
				*Present Wage earning capacity SAME	
				Compensation obtained: Year Not	
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 19-A.C.S. Case Record System
Futura Company, Inc.

FIG. 344. Fracture record of case shown in Figure 343.

panied by pain, a condition which necessitates the wearing of a shoe with the heel built up $\frac{1}{4}$ to $\frac{3}{4}$ of an inch.

I would also emphasize the advantage of using the Thomas splint in this type of fracture. It not only permits of measuring the leg for the purpose of seeing whether traction is bringing it back to its normal length, but it also permits the periodic taking of roentgenograms which show the rate of development of callus, and in addition, it permits the patient to draw up within the splint, preventing tuberischial pressure.

For years we have been taught that complete fixation of bone was necessary in order to get union. Personally, I am becoming more and more convinced that in certain long bone fractures it is not neces-

sary. A little play and motion at the point of fracture seems to hasten rather than retard union as long as there is no tissue interposed. This is proved every day by the fact that ribs and clavicles unite

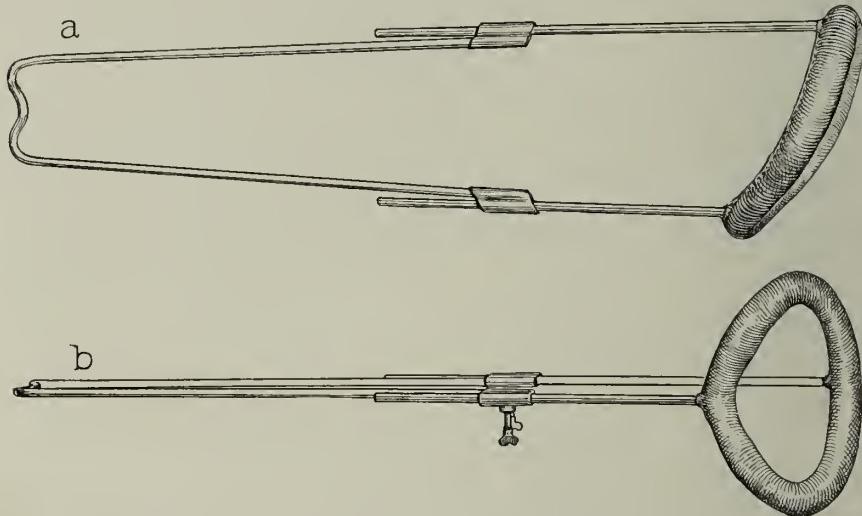


FIG. 345. Proper curve on ring of Thomas splint to avoid pressure necrosis of perineum.

by bony union, yet it is impossible to immobilize them completely because of the cycle of respiration.

If, however, a Thomas splint cannot be secured, the patient must be placed on a Hawley table and a body cast applied, with the limb in a position of *abduction*. The cast should extend from the lower costal margin down the entire affected limb and embrace the other limb to the knee. A Buck's extension should also be applied.

After the splint has been removed, at the end of eight or twelve weeks, the patient should be kept in bed for another two or three weeks and measurements (Fig. 337) made about every third day, to make sure that callus formation is progressing satisfactorily without shortening. If callus formation takes place slowly, as may be the case in elderly people, it may be necessary to reapply the Thomas splint and Buck's extension to prevent shortening of the leg but additional push and pull are not necessary.

After the removal of the Thomas splint and Buck's extension, massage and passive and active motion may be begun, and gradual weight-bearing instituted with the aid of crutches. A month or six

weeks after removal of the Thomas splint the patient may walk with the aid of a cane, and after another month has elapsed he may walk without support. *Elderly people and others in whom callus formation takes place slowly should wear a walking caliper*, with the weight placed on the tuber ischium, during the first two to four months of attempts at weight-bearing, otherwise a shortening is almost sure to develop. It is better to be conservative with these patients and use the caliper to prevent direct weight-bearing until six months from the date of injury, with frequent measuring to check against shortening.

COMPLICATIONS. The complications to be especially guarded against are shortening of the leg and genu recurvatum accompanied by pain. When shortening of the leg has occurred to the extent of half an inch or more, an orthopedic shoe is helpful. Sometimes shortening of even half an inch causes reflex pain in the back; in this case, building up the heel and sole of the shoe is advisable. As previously mentioned, when genu recurvatum occurs an orthopedic shoe with a raised heel may become necessary. A Thomas splint, unless properly molded to conform to the contour of the perineum, is likely to create a great deal of pain and trouble such as pressure necrosis, particularly if the ring used is a flat one. I have seen one death from pressure necrosis of the perineum following use of the flat ring. Therefore I advise the use of the ring shown in Figure 345.

Nerve lesions (p. 405) occur only very rarely. They may be found in cases which have been treated surgically, a method absolutely unnecessary in this type of fracture.

PROGNOSIS. The disability period extends over six to eight months, except in older patients, who may be disabled for nine months to a year. If the case is properly treated, no specific loss of function follows this injury, although constant vigilance is necessary during the period of treatment to prevent shortening of the limb. In cases of genu recurvatum, the patient, of course, suffers a specific loss of function. It is not unusual to find a shortening of from one-half to one inch in these cases, but I feel satisfied that it can be practically eliminated if proper precautions are taken, *as the after-care is all-important. A surgeon treating these cases cannot apply a traction apparatus and expect it to function by itself indefinitely.*

That is impossible. Careful observation, checking up of measurements, watching weights and abduction are absolutely essential.

There are some mechanical splints on the market. Many physicians using them are under the impression that once applied, no subsequent attention is necessary. No greater mistake in judgment was ever made.

FRACTURE OF THE SURGICAL NECK OF THE FEMUR

This type of fracture occurs 2 to 6 inches below the intertrochanteric line. It may be simple or multiple in type, and occasionally may be compound, although this is exceedingly rare.

SYMPTOMS. This injury is marked by immediate disability, extreme pain upon any attempt at movement, marked deformity, effusion, ecchymosis, muscle spasm, crepitation and preternatural mobility. Many patients suffer from shock. The patient usually lies with the limb hyper-rotated externally, the outer side of the foot resting flat on the floor. The roentgenogram is an important supplement to these symptoms in the making of a diagnosis.

TREATMENT. If a surgeon recognizes this type of injury immediately after the accident and before the patient has been moved, a Thomas splint with an extension may be applied temporarily, and the patient removed to the hospital in a fair degree of comfort. The clothing need not be removed in order to apply the splint. The patient is first given a quarter of a grain of morphine. Then the physician grasps the patient's ankle with both hands and, using gentle and gradual traction, plays out the muscle spasm until the limb is in full extension with some abduction. With the limb held in this position the Thomas ring is passed over the foot and up the limb, being firmly placed against the perineum. A bandage tied about the shoe and attached to the end of the splint permits movement of the patient with comparatively little discomfort.

As in fracture of the intertrochanteric line of the femur, fracture of the surgical neck must be treated by a physician who has familiarized himself with the principles of muscle balance. The muscular attachments involved in this type of fracture are even stronger than those in fracture of the intertrochanteric line, so that it is simply impossible to pull the short fragment into alignment by means of straight traction with any degree of success.

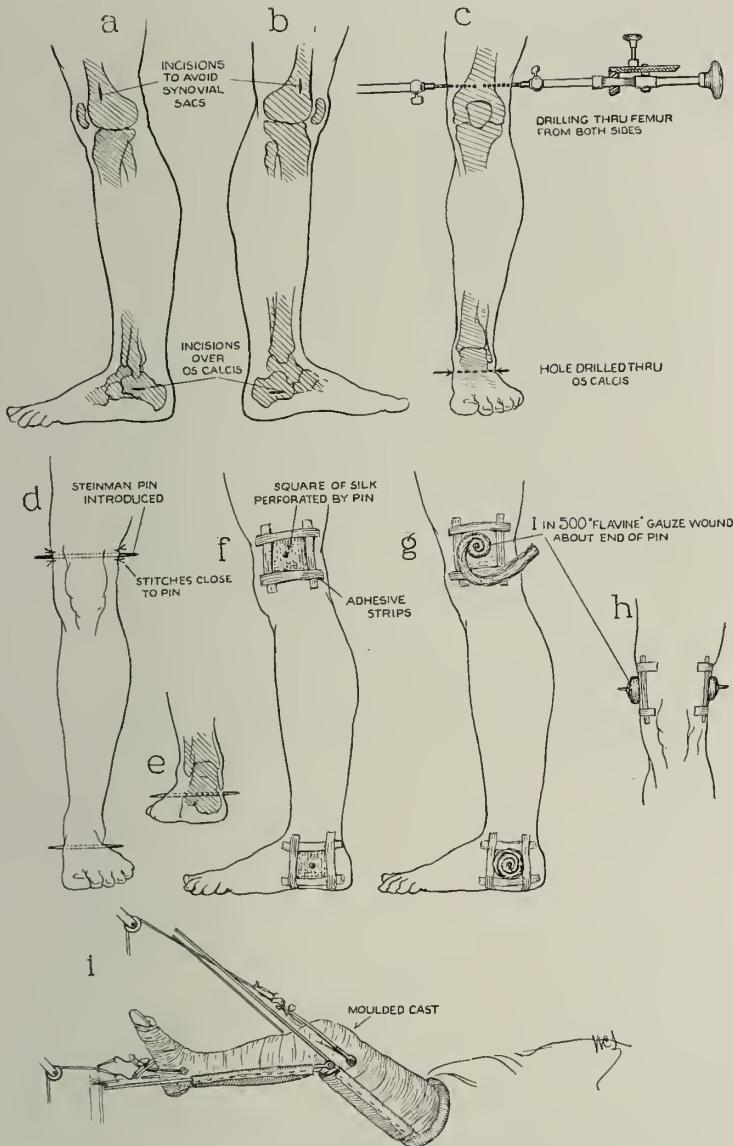


FIG. 346. Technique of Steinman pin. Note drill penetrating from both sides (instead of one side only) to avoid wrong angulation. Note also gauze saturated in 1:500 acriflavine.

After the patient has rested quietly for twenty-four to thirty-six hours, a Thomas splint or a body cast may be applied, with the limb in full abduction. In addition, a Buck's extension should be used, this



FIG. 347.

FIG. 348.

FIGS. 347 and 348. Fracture of middle and lower third of femur, using Steinman pin. Lateral view shows some forward angulation, which is much more satisfactory as normal femur has forward bowing.

extension calling for a weight of 20 or 25 or sometimes even as much as 40 lbs.; or a caliper, or ice tongs, or a Steinman pin through the condyle of the femur may be employed. *These latter appliances require a weight of only 10 to 15 lbs.*, for the maintenance of traction, because here there is a skeletal pull only.

If a Steinman pin is inserted, the operation is performed under general anesthesia. Two incisions are made, one on each side of the condyle. These incisions are made high enough to avoid the synovial capsule. A drill of the same size as the pin, or a fraction smaller, is introduced through the cortical layer of bone. Leaving the drill *in situ*, take the Steinman pin and follow along the drill. Carefully remove the drill and drop the end of the Steinman pin into the open-

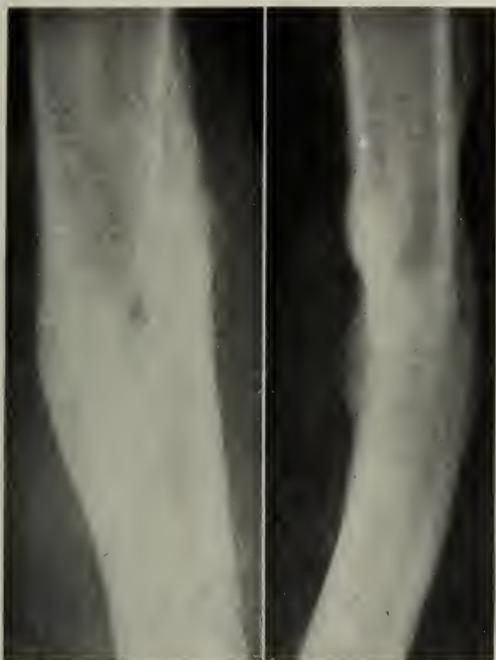


FIG. 349.

FIG. 350.

Figs. 349 and 350. Same case as Figures 347 and 348, six months later, showing good union but still forward angulation. Result emphasizes necessity of close, careful observation throughout course of treatment of any fracture. (See chart, Fig. 351.)

FRACTURE RECORD

Name J.M.	Address 616 GREEN STREET	Case No. 66289									
Age 24	Sex MALE	M.F. M.S.W.	White or Colored	Date 10-2-25 Hr. 3:00 P.M.							
Occupation CARPENTER	Dr. Dr. Forrester										
Cause of Fracture HEAVY OBJECT FELL STRIKING HIM ABOUT FACE, LEFT SHOULDER, AND HE FELL TO GROUND.											
X-Ray No 26404											
Time of Occurrence of Accident											
Hospital Entered FRANCES WILLARD											
First Treatment DR. VALENTINE.											
Final Reduction											
EXAMINATION					TREATMENT			RESULT			
Bone RADIUS AND FEMUR					Closed Reduction			Anatomical	Good	Moderate	Bad
Site WRIST AND MIDDLE 1/3					Method and Position of Fixation WRIST REDUCED UNDER GENERAL ANAESTHETIC			Functional	X	X	X
Type:					Anatomical Result obtained GODD POSITION OF FRAGMENTS			Description of End Result, including Disability, Shiner, & Function. Palp. Swelling. Nerve.			
Fracture								(a) At discharge from hospital Date 12-22-25			
Concussion								LEFT HOSPITAL ON CRUTCHES, APPEARED AT OFFICE FOR ELECTRICAL TREATMENT AND MASSAGE,			
Torn Joint											
Subperiosteal											
Greenstick											
X Comminuted.					Open Reduction						
					Method and Position of Fixation STEINMAN PIN INTRODUCED INTO CONDYLES OF FEMUR & DR Traction.						
					Anatomical Result obtained			(b) At discharge from O.P.D. Date 10-11-25			
					GOOD ALIGNMENT OF BONES OF FEMUR			WALKED WITHOUT LIMP, SLIGHT BORING OF FEMUR. 1/4 INCH SHORTENING.			
Nature and Extent of Injury to Soft Parts											
bruise burns to face.					Was non-operative treatment tried first? YES						
EDMATOMA AND INJURIES TO SOFT TISSUES					How long after injury was operation performed? 2 WEEKS			Disability: Absent. Partial Complete			
OF RIGHT LEG.					Was internal fixation material subsequently removed?			1 YEAR AND 1 WEEK TOTAL TEMPORARY			
X-Ray					Why			Mortality - Date			
Before Reduction OVERRIDING OF FRAGMENTS					When			Date of death			
After Reduction GOOD ALIGNMENT					Period of Complete Immobilization 10 WEEKS			Absence from work: Duration 1 YEAR AND 1 WEEK			
At Discharge GOOD CALLUS AND ALIGNMENT					Period of Protection 16 WEEKS			*Ability to resume job YES			
Wassermann Test NEGATIVE					Total Period of Protective Treatment 18 WEEKS			*Present Wage earning capacity SAME			
								Compensation obtained: Yes? 105 WEEKS PERMANENT			
								*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion			

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Futura Company, Chicago)

FIG. 351. Fracture record of case shown in Figures 347 to 350.

ing, then carry it through in the regular manner by a slow twisting motion with gradual pressure. A piece of gauze saturated with an acriflavine solution (1 to 500) is wrapped about the exposed portion



FIG. 352. Fracture of femur before introduction of Steinman pin.

of the pin on each side and bandaged. The traction apparatus, with a weight of only 10 or 15 lbs., and the Thomas splint, are then applied, the limb being placed in abduction, with the thigh flexed at an angle of 50°.

The Steinman pin need not remain in place for more than six to eight weeks, after which a straight Thomas splint, with traction, the limb being in the position of abduction, can be used; or a plaster cast with movable knee-joint splints (see Fig. 380) can be put on. If the Steinman pin is left in place too long, bone necrosis is apt to occur. Upon removal of the pin, in order to prevent a chronic sinus, a syringe containing ether and iodoform can be used in irrigating the tract, with excellent results.



FIG. 353.

FIG. 354.

FIGS. 353 and 354. Same case as Figure 352, four days later. Lateral and anteroposterior views.

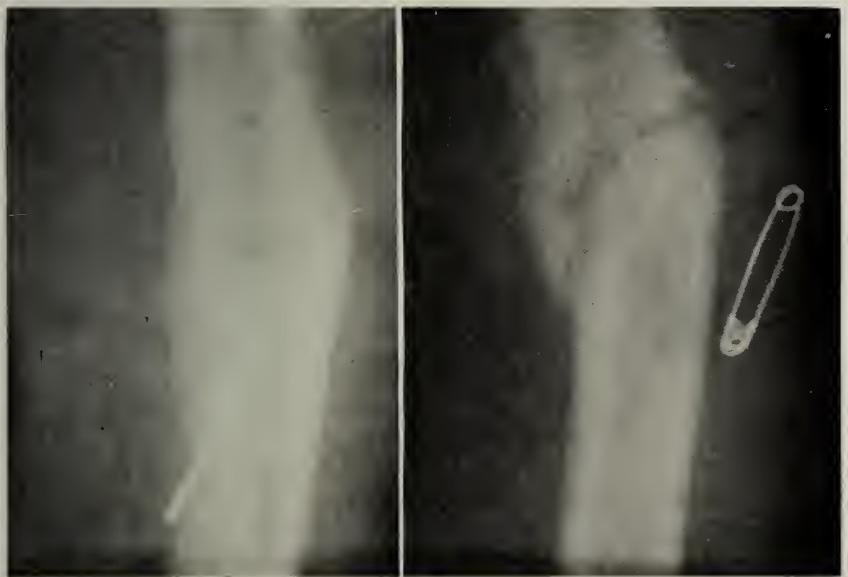


FIG. 355.

FIG. 356.

FIGS. 355 and 356. Same case as Figures 352 to 354, two months after accident.

If a proper reduction cannot be obtained where the pin is not used, or, if obtained, cannot be maintained, an intramedullary beef-bone peg (p. 267) may be inserted, and with it may be used the



FIG. 357. Another ease. Roentgenogram taken after removal of Steinman pin. Introduction of knee splints, showing alignment of fracture and efficiency of early motion.

Thomas splint with knee hinge that permits flexion of the knee joint. In such cases, it is advisable to show the roentgenograms to the patient and explain the necessity for the procedure.

The Steinman Pin. The Steinman pin is the appliance I prefer where metal traction is used, since I know that it will allow for continuous traction. If calipers or tongs are used, traction may be



FIG. 358.

FIG. 359.

Figs. 358 and 359. Same case as Figure 357, three months after injury, showing use of Steinman pin. Roentgenogram of fracture with approximation, also perforations where pin was introduced.

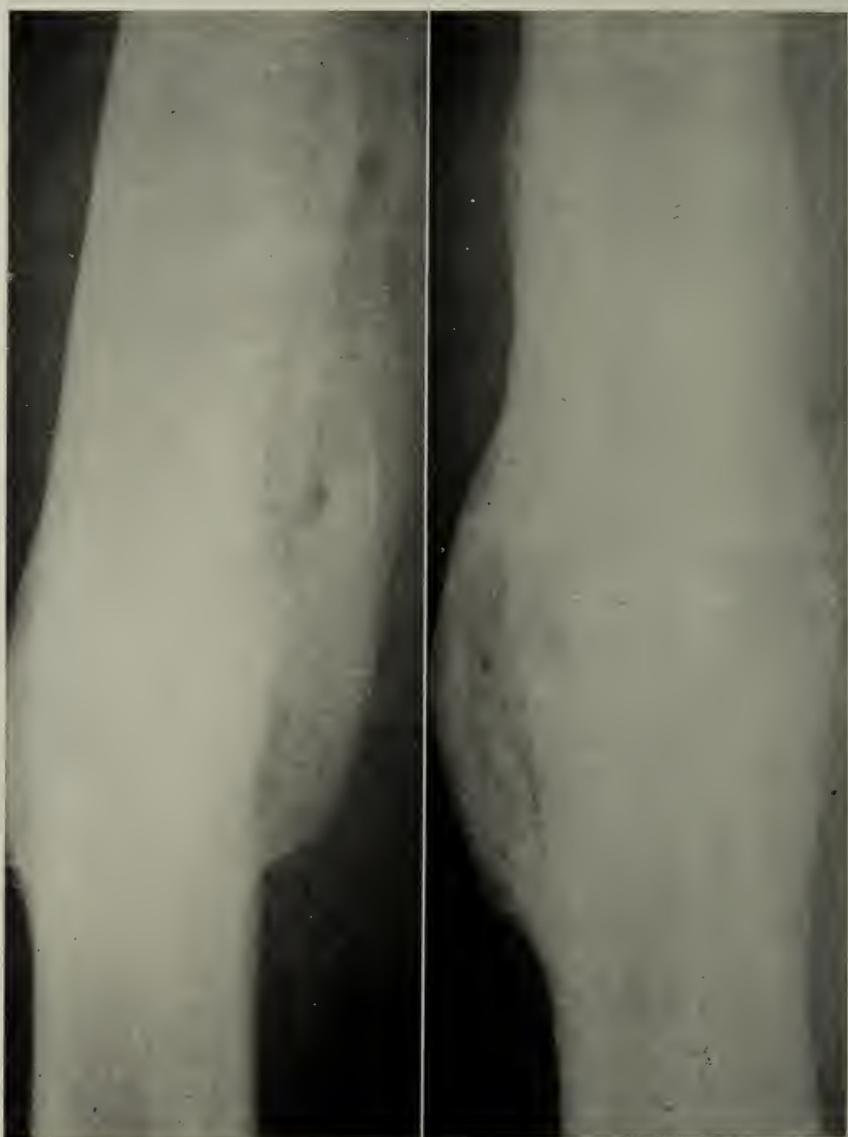


FIG. 360.

FIG. 361.

FIGS. 360 and 361. Same case as Figures 358 and 359, ten months after accident.



FIG. 362.



FIG. 363.



FIG. 364.

Figs. 362-364. Same case as Figure 357. Note weight-bearing line, degree of flexion in normal leg, and degree of flexion in fractured leg.

FRACTURE RECORD

Name	W.V.	Address	6751 S. OAKLEY BOULEVARD	Case No. 67658
Age	46	Sex	M.F.	Date 2-22-26 Mr. 10:15 A.M.
Occupation	FORERMAN			Dr. FORRESTER
Cause of Fracture	KNOCKED FROM A TRUCK			
		X-Ray No.	27452	
EXAMINATION		TREATMENT		RESULT
Bone	RIGHT FEMUR	Closed Reduction	Method and Position of Fixation	Good Moderate Bad
Site	MIDDLE 1/3	STEINMAN PIN WITH	Anatomical	X
Type	COMPLETE TRANSVERSE	SPLINTS ALLOWING MOTION IN KNEE	Functional	X
X-Scars	X-Transverse	Anesthetic Used	Yes No	
Compound	Oblique	Anatomical Result obtained	GOOD, NO SHORTENING	
True Joint	Stable			
Supplementary	Incorporated			
Groenewold	Comminuted	Open Reduction	Method and Position of Fixation	
Description of Deformity including shortening		POSTERIOR EXTERNAL DISPLACEMENT OF PROXIMAL FRAGMENT WITH OVERRIDING AND SHORTENING		(a) At discharge from Hospital Date 4-7-26 WEARING CAST WITH SPECIAL MOVEABLE KNEE ARRANGEMENT
Nature and Extent of Injury to Soft Parts especially nerves and vessels				(b) At discharge from O.P.D. Date 5-21-26 NO SHORTENING. SLIGHT ATROPHY OF THIGH MUSCLES.
RAGGED LACERATION ABOUT POSTERIOR SURFACE OF RIGHT THIGH				(c) At subsequent date Date 12-24-26 WORKING SINCE AUGUST. DISABILITY: Absent Partial Complete TEMPORARY TOTAL DISABILITY 6 MONTHS.
X-Ray		Before Reduction: OVERRIDING After Reduction: GOOD POSITION		Mortality Date Main cause of death
		Period of Complete Immobilization 2 MONTHS Period of Protection 4 MONTHS Total Period of Protective Treatment 4 MONTHS		Absence from work: Duration 6 MONTHS *Ability to resume job YES *Present Wage earning capacity SAME Compensation obtained: Yes? No?
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion

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FIG. 365. Fracture record of case shown in Figures 357-364.

interrupted, as the screws or tongs may work loose. With the Steinman pin one can use the entire bone thickness, whereas with caliper or tongs the grasp is uncertain and they may pull out and destroy the bone contour.

The Steinman pin not only makes possible the obtaining of traction by means of less weight than is required if Buck's extension is used, but it also permits of the taking of periodic roentgenograms for determining the degree of alignment. Furthermore, its use means that early motion of the limb at the knee may be instituted. The method of obtaining early motion is as follows: In conjunction with the Steinman pin, a Thomas splint is used, the additional portion of the splint having hinges at the knee, so that while traction is being applied, with the limb abducted and elevated, the knee can be dropped down in flexion. For traction, adhesive tape, preferably mole-skin or acetone plaster, can be placed along the bottom of the foot to the end of the toes and a loop run through a pulley to the head of the bed. The patient can be instructed to keep the knee joint in motion by pulling this loop, thereby eliminating the possibility of a stiff knee or a fibrous ankylosis of the knee, that may follow treatment with the Buck's extension. This early motion not only cuts down the length of the disability period, since the patient's knee joint is flexible when he begins weight-bearing (thus making unnecessary the employment of passive and active motion and massage); but it also increases bone proliferation about the site of fracture. As in fracture of the clavicle, the ribs and the patella, early motion does not hinder but increases the rate of healing. When the Steinman pin and the Thomas splint are used, above the knee, motion in the knee can be permitted seventy-two hours after operation.

The Steinman pin should not be used in those cases in which roentgenograms show that the cortex of the bone is not strong, as the bony structure may easily tear or break down. For these cases a Buck's extension, with the thigh flexed and abducted, should be employed, or an open operation, although in my opinion the latter is not necessary.

An objection to the Steinman pin is that it is usually divided in the middle and, when in use, threads into itself. Some pins, however, are now made of plain steel without section. In inserting the usual form I prevent possible breakage of the thread by first



FIG. 366.

FIG. 367.

FIGS. 366 and 367. Demonstration of use of intramedullary beef-bone peg on an old refractured femur. (See chart, Fig. 370.)

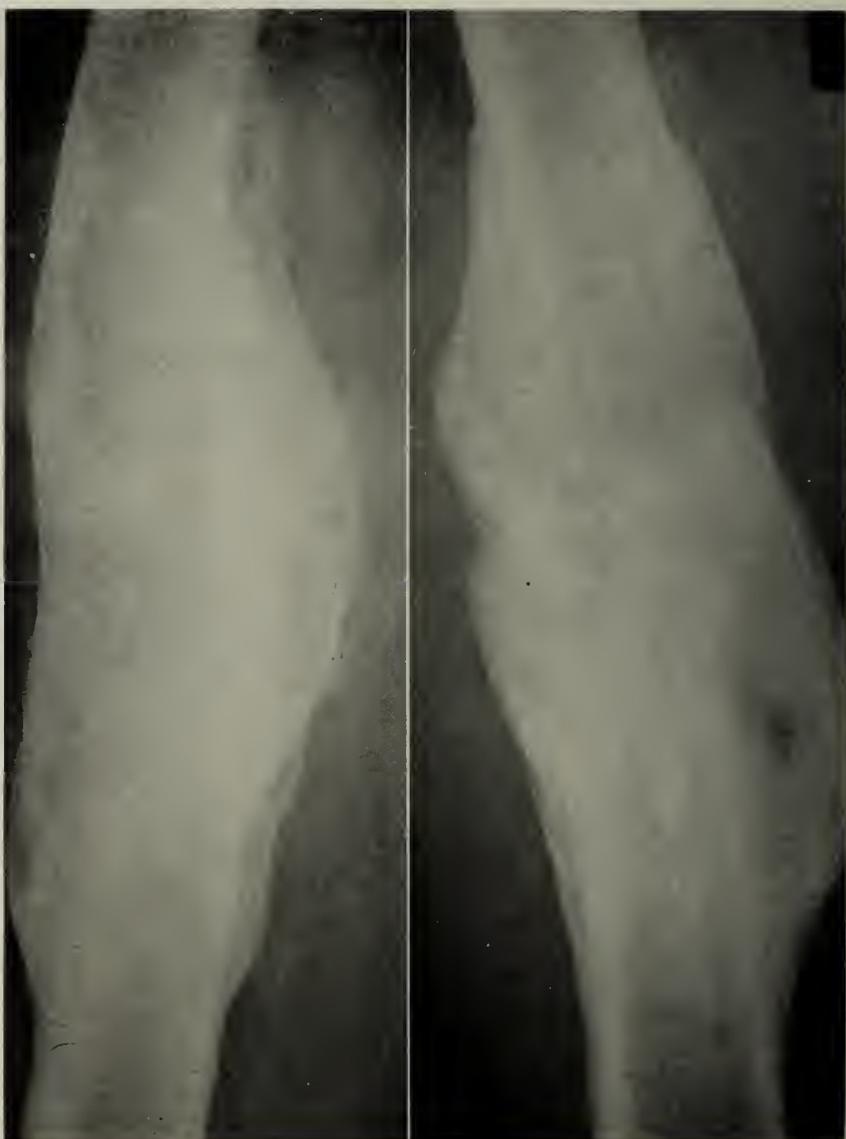


FIG. 368.

FIG. 369.

FIGS. 368 and 369. Same case, four months later, showing degree of absorption of bone peg. This case also had $\frac{3}{4}$ in. shortening from closed method of reduction when use of beef-bone peg prevented further shortening.

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drilling holes on each side. A solid piece of steel is preferable to the one that threads. In doing this the proper drilling plane should be carefully followed.

FRACTURE RECORD					
Name	H. M.	Address	5840 S., SACRAMENTO	Case No.	59657
Age	Sex	M. B.	M. S. W. D.	Date	5-1-26
White or Colored				Time: Occurrence of Accident	10:30 A.M.
				Hospital Entered	WEST SIDE
Occupation				First Treatment	5-1-26
Cause of Fracture WHEN STEPPING DOWN ONE STEP TWISTED RIGHT LOWER EXTREMITY.				Final Reduction	5-20-26
X-Ray No. 28965					
EXAMINATION		TREATMENT		RESULT	
Bone	FEMUR	Closed Reduction		Good	Moderate
Site	MIDDLE 1/5	Method and Position of Flexion		Bad	
Type:	OBLIQUE	Anesthetic Used	Yes	X	
State	Transverse	Anatomical Result obtained		X	
Comminuted	X Oblique			X	
Intra-articular	Spiral				
Subarticular	Impacted				
Gronwick	Comminuted	Open Reduction	YES		
Description of Deformity (including shortening)				Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve	
ONE INCH SHORTENING				(a) At discharge from Hospital Date 7-17-26	
				SLIGHT PAIN AND ONE INCH SHORTENING. 5/4	
				OF THIS SHORTENING WAS DUE TO OLD	
				FRACTURE IN OUR PREVIOUS RECORD.	
INTERMEDULLARY BONE PEGS				(b) At discharge from O. P. D. Date 12-24-27	
				GOOD POSITION ALIGNMENT	
				EXTENSIVE CALLUS FORMATION	
				INTERMEDULLARY PEGS ABSORBING	
Anatomical Result obtained GOOD					
				(c) At discharge date Date	
				Disability: Absent, Partial, Complete	
				TEMPORARY TOTAL 7 MONTHS	
Was non-operative treatment tried first? YES					
How long after injury was operation performed? 20 DAYS					
Was internal fixation material subsequently removed? NO					
Why WAS ABSORBABLE				Mortality	
When				Date	
Period of Complete Immobilization 2½ MONTHS				Main cause of death	
Period of Protection 5 MONTHS				Absence from work: Duration 7 MONTHS	
Total Period of Protective Treatment 7 MONTHS				Ability to resume job YES	
				Present Wage earning capacity SAME AS BEFORE	
				Compensation obtained: Yes?	
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 19-A.C.S. Case Record System
Futura Company, Chicago

FIG. 370. Fracture record of case shown in Figures 366-369.

PROGNOSIS. There will be seven to eight months' disability, usually with some true shortening, although it should be very little, particularly if definite traction and abduction with flexion are used. Functionally there is no loss of use. Where the shortening is considerable, a shoe with thickened sole and heel may need to be used in the adult to avoid backache.

FRACTURES OF THE SHAFT OF THE FEMUR

SYMPTOMS. This injury is characterized by pain, shock, distortion of the limb, swelling, and occasional external evidence of trauma and pronounced muscle spasm. There is definite shortening along the line between the anterior superior spine of the ilium to the internal malleolus. Roentgenograms are helpful in confirming the nature and extent of the fracture.

TREATMENT. I prefer the Steinman pin in combination with the Thomas splint as used in treatment of fracture of the surgical neck of the femur (Fig. 371). In those cases in which the roentgenograms

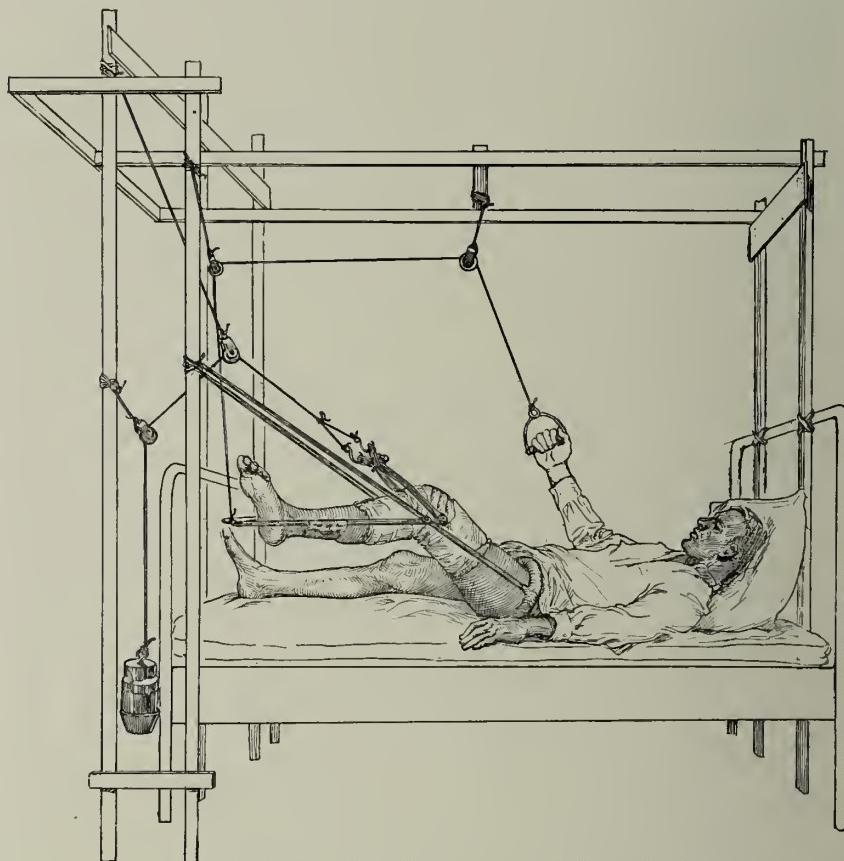


FIG. 371. Steinman pin and early motion in femur fractures.

show a weakness of the cortex of the bone, the intramedullary beef-bone peg may be used (Fig. 366). In cases in which the surgical risk is high, the straight Thomas splint with a Buck's extension is to be preferred. Often a simple reduction of these fractures can be obtained by using a Hawley table with traction, particularly in simple transverse fractures where the serrated edges can be locked.

In my clinics surgeons have asked why I discriminate between the Steinman pin and the ice tongs as calipers. My answer has

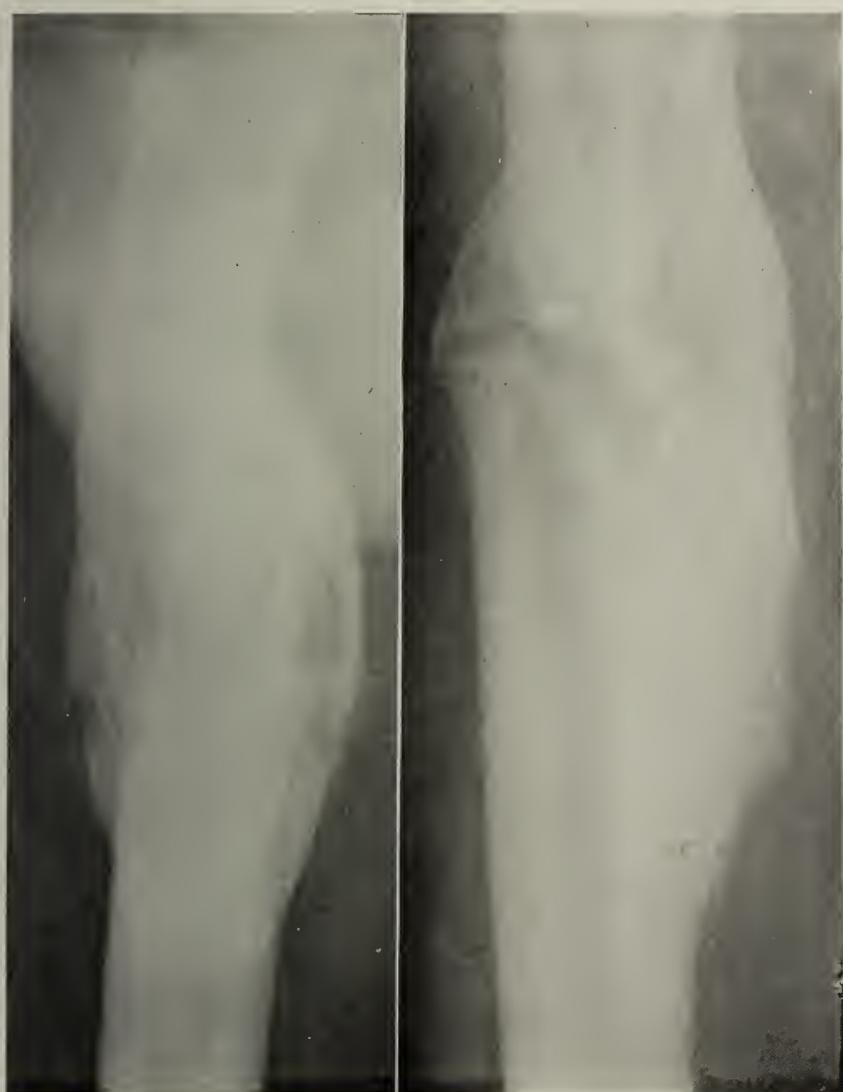


FIG. 372.

FIGS. 372 and 373. Roentgenogram taken two months after introduction of beef-bone peg showing alignment of femur and complete absorption of beef-bone peg.

FIG. 373.

universally been that one cannot always know the density or integrity of the cortical bone, and furthermore one must use continual precaution in the use of ice tongs or caliper almost daily, whereas



FIG. 374.

FIG. 375.

Figs. 374 and 375. Fracture of femur showing use of beef-bone peg for purpose of fixation and end-to-end apposition of bone. Position secured by traction in first instance.

with the pin such unusual precautions are not necessary. In advocating the use of the pin I have in mind the great number who are not schooled in the use of the tongs or caliper.

I do not wish to give the impression that I believe in surgically compounding all fractures. The surgical compounding of fractures



FIG. 376. Same case as Figures 374 and 375, showing loss of good position.

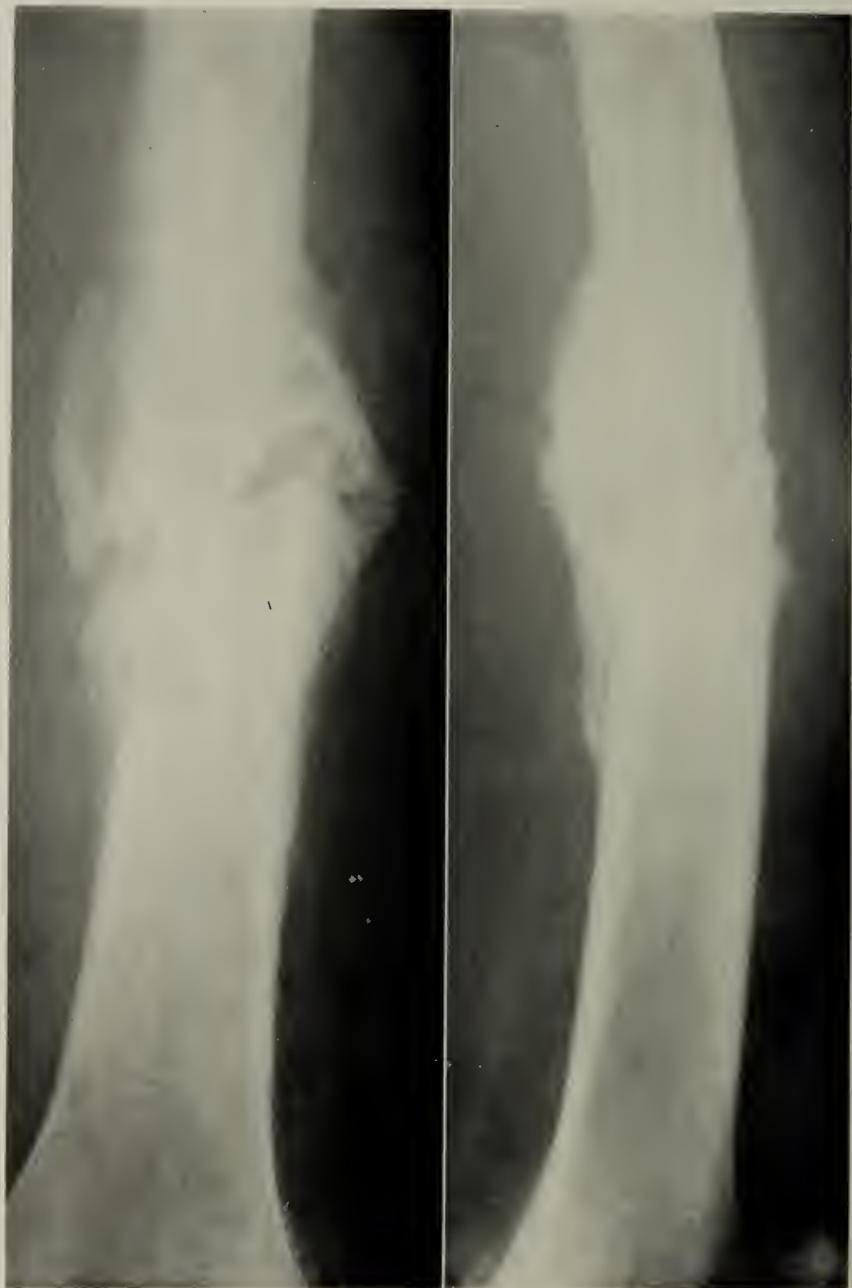


FIG. 377.

FIG. 378.

FIGS. 377 and 378. Same case as Figures 374 to 376, three months after operation, showing bone peg in place and good callus formation. Patient bearing weight on leg.

should not be daily routine, and when done, should be by one who has diligently trained himself in all its departments. It takes a great deal of training, a *thorough* knowledge of anatomy and a very careful handling of tissues to be successful in this department of surgery.

PROGNOSIS. The disability period extends over six to nine months, and the patient may be left with a permanent shortening of the leg. Complications involving the knee, as mentioned on page 251, must be carefully avoided.

FRACTURES OF THE MIDDLE AND LOWER THIRD OF THE FEMUR

SYMPTOMS. The symptoms of this injury include shock, pain, almost always increased swelling of the synovial bursa, distortion (the lower limb is usually rotated externally), true shortening (from the anterior superior spine of the ilium to the internal malleolus) and definite muscle spasm with crepitus. The roentgen ray is an excellent supplement in making the diagnosis.

TREATMENT. The symptoms of shock should be treated with morphine and atropine. A temporary reduction of the fracture, with the knee in a position of 15 to 20° flexion, should be done in order to avoid any pressure on the popliteal vessels and nerves. The limb should be placed in a fracture box or surrounded with sandbags. As soon as the swelling subsides, which takes place in ten days to two weeks, further treatment can be instituted.

One trained in the use of local anesthesia as advocated by Böhler of Vienna can reduce such fractures immediately, the moment the patient is brought into the hospital.

In the treatment of this injury it should be kept in mind that to the short or distal fragments of the fracture are attached the heavy gastrocnemius muscles, and that muscle spasm draws these distal fragments backward and downward, thus rendering the vessels and nerves in the popliteal space subject to injury. For this reason a straight Thomas splint with a Buck's extension should *never* be applied, as there may result pressure necrosis or laceration of the popliteal vessels or nerves. I have on record a case in which amputation above the knee had to be performed as a result of placing the fractured limb in a Thomas splint with a Buck's extension without knee flexion.

A Steinman pin (p. 257) or, in cases in which reduction of the fracture is maintained with difficulty, an intramedullary beef-bone peg (p. 270) should be used. The Steinman pin gives far the better result of the two, since in spite of any amount of care, backward displacement of the distal fragment may follow the use of the bone peg; furthermore, with the use of the pin, a Thomas splint with knee hinge can be used and early motion begun in the knee as previously described. It does not interfere with union. I have, however, employed the beef-bone peg using a cast with knee splints in position, resorting to passive motion in two to three weeks, with gratifying results.

Either of these appliances should be supplemented by a Thomas splint which allows for flexion of the knee to an angle of 40° and with which is combined slight traction in the use of the pin on the leg to the knee; or by a cast in which are incorporated the knee splints allowing motion at the knee. The Steinman pin need not be left in longer than five to six weeks, sufficient time to develop a callus. Then traction or a cast with knee splints may be used, preferably the latter.

Introduction of the beef-bone peg in this vicinity is not a difficult operation for a surgeon thoroughly familiar with knee-joint anatomy. An incision should be made on the upper and outer side of the knee and, following the fascial planes, should pass down between the vastus externus and rectus muscles, being sure to avoid the synovia. This incision gives an excellent exposure of the fracture.

Providing one is experienced he can go into the knee joint proper with impunity, but I do not advise the average surgeon to try it without a certain amount of training.

COMPLICATIONS. Improperly inserted Steinman pins will cause infection if too close to the synovia. If not removed in five to six weeks a bone sinus may follow. This can usually be avoided by irrigating the wound with a composition of iodoform and ether in a syringe, using about 14.78 c.c. of iodoform to 59.15 c.c. of ether.

Involvement of the vessels in the popliteal space may occur if the flexion at the knee is not watched.

Where the technique of surgical compounding is not carefully observed and infection follows, osteomyelitis may be the result. *This can be materially avoided if the compounding is done ten days to two weeks after the fracture occurs.*



FIG. 379. T-fracture of lower end of left femur. Anteroposterior view.

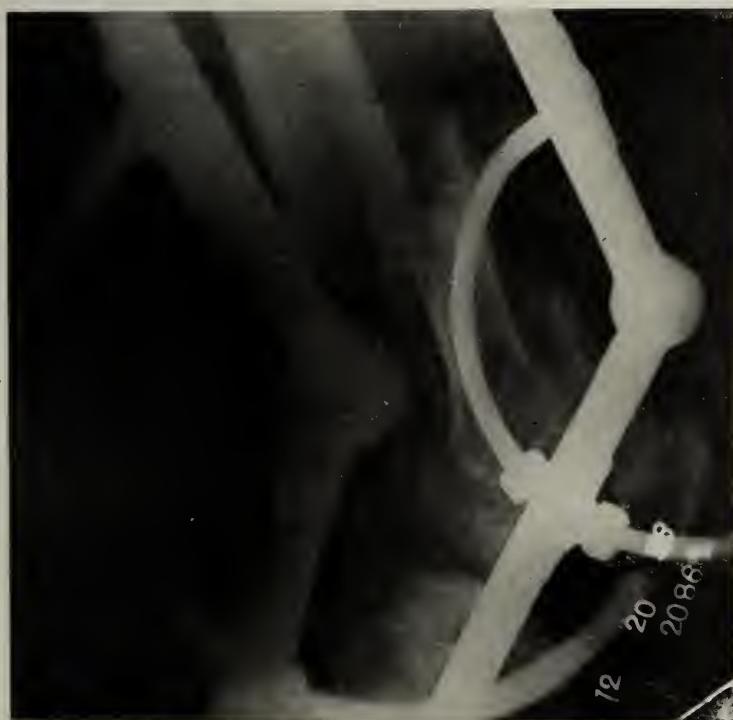


FIG. 380. Same case as Figure 379, with knee splints applied. Lateral view.

〔277〕



FIG. 381. Same case as Figures 379 and 380, lateral view.



FIG. 382. Same case as Figures 379 to 381, showing amount of motion obtained.

INJURIES OF FEMUR

279

PROGNOSIS. The period of disability extends over six to nine months. If the Steinman pin or beef-bone peg with a Thomas splint is used, shortening practically never occurs.

FRACTURE RECORD			
Name	A.S.	Address	Case No. <u>76190</u>
Age	36	Sex	Date <u>12-1-26</u>
Occupation	M. F.	M. S. W. D.	Hr. <u>12-6-26 TH. FROM GARY IND.</u>
Cause of Fracture	FELL ABOUT 5 FEET, RECEIVING FRACTURE OF LOWER FEMUR.		
	First Treatment TO WEST SIDE HOSPITAL.		
	X-Ray No. 20846 Final Reduction		
EXAMINATION		TREATMENT	RESULT
BONE COM. T-FRACTURE L. FEMUR, TRANSVERSE SCALING 3 IN. PROX. TO DISTAL HEAD, LONG TYPE: LIMB EXT. DOWN BET. CONDYLES INTO KNEE JOINT. ALSO LONG. FRACT. OF PATELLA NO DISPLACEMENT.		Closed Reduction 12-17-26 WITH TRACTION ON HARLEY TABLE. PLASTER CAST FOOT TO AND AROUND THIGH AND ABDOMEN, IMMOBILIZING KNEE JOINT AND INCORPORATING INTO THE ABDOMINAL WALL. 100° FLEXION AT KNEE. CAST METAL RINGED KNEE SPLINTS, TO START EARLY PASSIVE MOTION IN KNEE.	Good Moderate Bad
From Joint		Open Reduction	Anatomical
Subluxated			Functional
Genuvalgus			Description of End Result, including Deformity, Shortening, Function, Pain, Sensation, Nerve (a) At discharge from Hospital Date <u>1-22-27</u>
Description of Deformity including shortening		PASSIVE MOVEMENT STARTED MIDDLE OF 2ND WEEK. 12-21-26 X-RAY EXAM. SHOWED APPARENT L.I.P. IN ALIGNMENT OF FRACTURES. 1-6-27 CAST REMOVED. 100° FLEXION AT KNEE JOINT, FRACTURES GOOD ALIGNMENT. SUPPORT	100° FLEXION. 2-26-27 CAME TO OFFICE BY AID OF CRUTCHES FOR HEAT AND MASSAGE TREATMENT. 3-2-27 BEGAN WEIGHT-BEARING ON LIM. LEG. 3-5-27 ATROPHY OF THIGH AND CALF MUSCLES. 100° FLEXION. FULL WT.- BEARING. 4-12-27 WALKED WITHOUT CANE OR CRUTCH. ALMOST COMPLETE MOTION RE- ESTABLISHED. 12-1-27 HAD WITHIN 50° FULL FLEXION. NO LIM. IN EXTENSION.
Nature and Extent of Injury to Soft Parts especially nerves and vessels		X-RAY EXAM. SHOWS MUCH CALLUS FORMING.	(b) Ambulatory date Date
		How long after injury was operation performed?	Disability: Absent, Partial, Complete
X-Ray		Was lateral fixation material subsequently removed?	
Before Reduction COM. T-FRACT., LEFT FEMUR.		Who	Mortality Data
After Reduction SL. POST. ANGULATION OF DISTAL FRAG. 70° END TO END APPOSITION OF FRACTURES. Wiersmann Test NEGATIVE.		When	Main cause of death
		Period of Complete Immobilization	Absence from work: Duration
		Period of Protection	*Ability to resume job
		Total Period of Protective Treatment	*Present Wage earning capacity
			Compensation obtained: Yes? No?
			*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion

Form 15 (A. S. Case Report No. 273)

FIG. 383. Fracture record of case shown in Figures 379-382. Patient now working at former occupation, with no specific loss.

FRACTURES OF ONE OR BOTH CONDYLES OF THE FEMUR

SYMPTOMS. These fractures are characterized by pain, marked effusion into the knee joint, definite muscle spasm, crepitus, marked limitation of motion, distortion of the knee joint and fluctuation of the fluid within the capsule. Anteroposterior and lateral roentgenograms are of great assistance in the establishment of a diagnosis.

TREATMENT. The fractured limb should be put into a fracture box for two weeks with the knee in 10° to 15° flexion, and ice packs or hot applications used. Reduction may then be performed under general anesthesia. Reduction of this fracture consists of flexion of the knee to pretty nearly a right angle; then, with heavy traction on

the lower leg, the surgeon should attempt to manipulate the fragments upward and if possible lock them against opposing surfaces. Great care should be taken in placing the joints of the knee splints directly over the condyles. After reduction, a cast should be applied extending from the thigh to the foot, in which knee splints are incorporated.

Sometimes, or I might say usually, it is advisable to place the knee in 30° to 40° angle at first to take the pull off the gastrocnemius until the primary callus takes place, which means ten days to two weeks before splint motion is instituted.

In regard to motion of the knee joint where knee splints are used the limb should be placed in full extension at night and in flexion during the day, a little more flexion being obtained each day.

If both condyles are fractured, the knee splints should be applied with the knee in nearly full extension where the bones are locked without displacement, and motion should not be instituted for two to three weeks after reduction. If only one condyle is fractured, motion may be instituted seventy-two hours after operation.

PROGNOSIS. A disability period of six to eight months' duration must be expected. If both condyles are fractured, the patient will be left with a certain specific loss of function; if only one condyle is fractured, loss of function will be very slight.

CHAPTER XIV

INJURIES OF THE KNEE

ACUTE RUPTURE OF SEMILUNAR CARTILAGE OF THE KNEE

THIS condition, unless carefully handled, causes prolonged disability. It is the result of a sudden twisting of the knee, in which there is an inward rotation of the knee toward the inner side of the leg, accompanied by flexion.* This condition is not recognized as readily as it should be, and American surgeons have not made sufficient study of it.

SYMPTOMS. Unless the patient gives a definite history of an injury causing a sudden inward twisting of the knee with flexion that is followed by locking, it may be difficult to determine whether the condition is a traumatic synovitis or a simple synovitis with a semilunar lesion. Moreover, the symptoms *sometimes* fail to indicate whether the internal or external cartilage is affected. The injury causes pain, spasm and marked effusion and tenderness over the attachment of the semilunar to the inner part, where it fuses with the internal lateral ligament at the inner tibial head. Sometimes when the patient comes to the physician the knee is locked, full extension being impossible; or the patient may merely tell of temporary locking following the accident. In rare cases the examiner, in manipulating the knee, can produce locking.

TREATMENT. If there is locking, the physician must attempt to reduce it by inward rotation and flexion followed by extension. Because of the pain this usually will have to be done under general anesthesia. If reduction cannot be accomplished, the patient should be kept quiet for a week or ten days and then the operation described on page 284 performed.

If reduction can be effected by manipulation, or in cases in which reduction has been inadvertently effected before the physician is consulted, a plaster cast should be applied with the knee in a position of 10° flexion. The limb should be maintained in this position for at least four to six weeks. Passive and active motion with massage may then be instituted, and when practically all swelling has disappeared,

* Jones, Sir Robert, and Lovett, R. W. Orthopedic Surgery. Wood, N. Y., 1923.

gradual weight-bearing with the aid of crutches may be begun. An elastic stocking together with proper contraction education of the quadriceps allows the patient to return to work at an early date. These cases must be very carefully watched after their return to work, since the difficulty of obtaining proper healing of the cartilage is great and locking may again occur after the patient to all appearances is well enough to work.

COMPLICATIONS. Complications are sometimes caused by the difficulty of determining whether the external or the internal cartilage is affected and the wrong condition may be treated until operation reveals the true state of affairs. Rupture of the external cartilage occurs only very rarely. Rupture of one or more of the crucial ligaments may take place, or a loose piece of cartilage may tear away from a femoral condyle and complicate the diagnosis. Occasionally tuberculosis of the knee, hypertrophic arthritis or osteochondritis dissecans follows this injury. Occasionally a fat tag may develop and form a free body. I have recently removed one the size of an English walnut.

PROGNOSIS. A disability period of two to four months must be anticipated in every case. Prognosis must be carefully guarded, since it is extremely difficult to determine whether complete healing has occurred. The only thing to do is to allow these patients, when their condition seems to warrant it, to return to work and then watch them carefully for signs of a relapse.

CHRONIC RUPTURE OF SEMILUNAR CARTILAGE OF THE KNEE

This condition may be due to improper treatment of the acute form or to the fact that the condition was not recognized and so not treated at all directly after injury.

SYMPTOMS. The patient complains of inability to work because of pain and tenderness, and intermittent locking or "giving way" of the knee. He may give a garbled account of his symptoms following injury but usually he will tell of an inward twisting of the knee. He may tell of locking of the knee upon sudden turning or twisting; or he may say that something "slips" in his knee. Almost all patients will tell of "working with" the knee in order to reduce the locking and all will complain of swelling following the locking.

TREATMENT. Surgical treatment is necessary in these cases, since either a plaster cast, a knee bandage or a knee pad is ineffective. Removal of the semilunar cartilage, according to the method of



FIG. 384. Position of approach to internal semilunar cartilage.

Sir Robert Jones, is described in the following paragraphs and in Figure 385. I was taught this method by Sir Robert Jones and Mr. T. R. W. Armour of Liverpool during the World War.

To begin with, any surgeon performing this operation should be thoroughly familiar with the anatomy of the knee joint and, if not, should first perform the operation several times upon a cadaver. The operation is a difficult one and the chances of failure too great for a

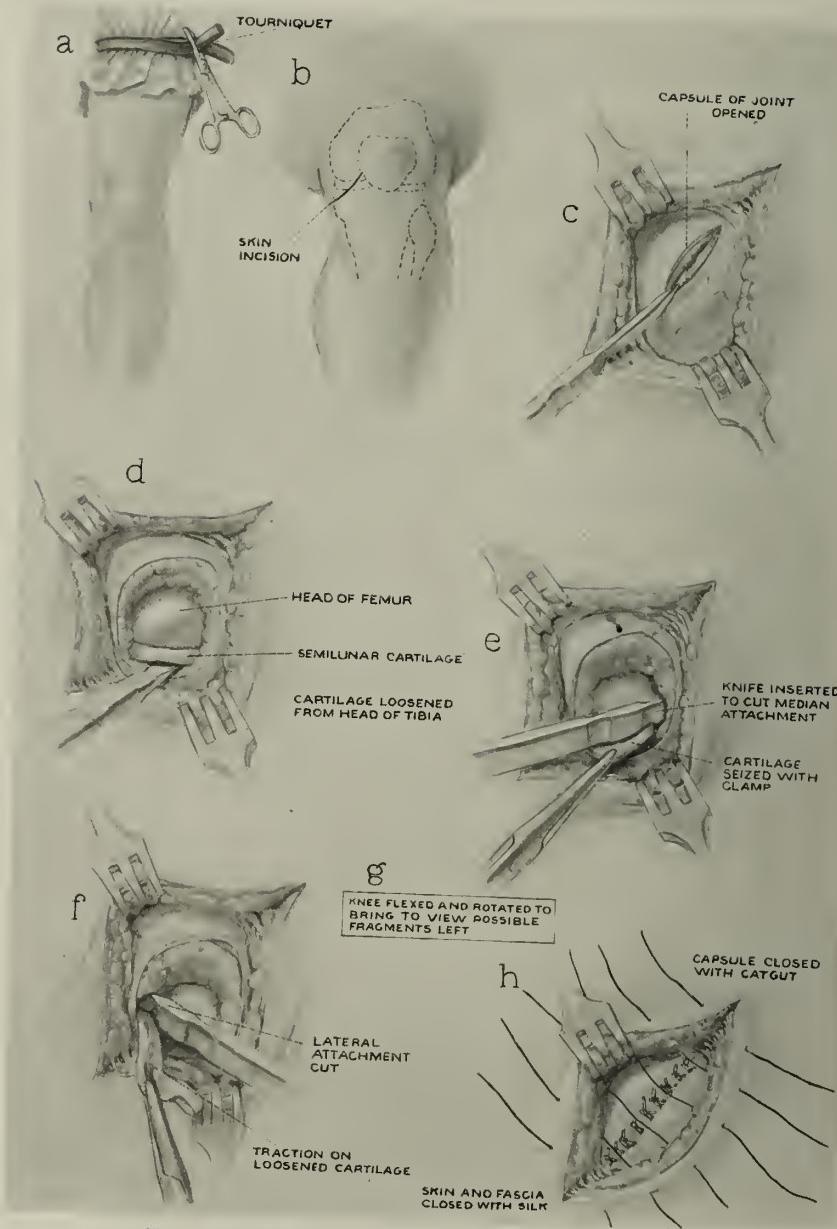


FIG. 385. Operation for removal of semilunar cartilage.

surgeon inexperienced in this type of work to take any risks of causing further injury to the knee. *A surgeon doing this work must not think he is clean; he must know.*

The knee should be prepared the night before by shaving and washing with soap followed by plain water and ether. A sterile dressing should be put on. In the morning the knee is painted with iodine, then washed with alcohol. During the operation no other part of the body except the knee should be exposed (Fig. 384). The whole operation should be conducted with the strictest attention to aseptic technique. No fingers should touch the wound, all instruments must be sterile, only the operating portion of the instrument should come in contact with the wound, and all knots should be tied with forceps.

The various steps of the operation are shown in Figures 384 and 385. In closing the capsule a Reverdin needle holder can be used to advantage, the assistant holding the suture in forceps. No. 1 pyocyanin catgut, plain, is used for closing the capsule and silkworm gut for closing the skin. A large puff dressing should be applied to the area of operation, the limb placed in 10° flexion and a posterior molded cast applied to the back of the leg.

Weight-bearing can be begun two or three weeks after operation. The cast is removed three weeks after operation and gentle passive and active massage begun. Five to eight weeks after operation the patient should be able to walk without the use of an artificial support.

COMPLICATIONS. All focal or systemic infections should be treated before operation, as they may cause very serious complications. For example, infected teeth or such a disease as syphilis may bring about unfavorable results after a technically perfect operation. I have in mind a patient who was operated on successfully for removal of cartilage. No infection showed itself until nine weeks after operation when a distinct effusion within the capsule of the knee joint developed, the line of incision broke down and a seropurulent exudate formed. In the region of the knee there was nothing to account for the infection. A general physical examination, however, showed that practically every tooth was abscessed. Although the patient's mouth condition was remedied, nothing could be done for the stiff knee joint. Such a case serves to emphasize the importance of careful preoperative examination and the treatment of any focal

or systemic infection. Ruptured internal lateral ligaments or crucials will tend to prolong and complicate disability, hence the necessity for examination for these complications.

Postoperative effusion within the capsule occasionally occurs. In such cases, the patients must be instructed in the contracting of the quadriceps muscles frequently during the day in order to bring about absorption of the fluid. The wearing of an elastic stocking is also helpful.

Grating in the knee joint sometimes occurs months after operation and is due to the formation of numerous cartilaginous bodies in the fat pads within the knee joint. It tends to complicate the ultimate outcome.

PROGNOSIS. The disability period in uncomplicated cases extends over two and one-half or three months and should be followed by no specific loss of function.

OSTEOCHONDRITIS DISSECANS (LOOSE BODIES IN THE KNEE JOINT)

This condition is sometimes confused with conditions involving the semilunar cartilage. Trauma may be an exciting factor, but many cases give absolutely no history of injury.

SYMPTOMS. If the calcified loose bodies are sufficiently large to interfere with the function of the knee joint, the symptoms are practically the same as in injury of the semilunar cartilage. Sometimes the loose bodies may be felt on palpation. Occasionally a section of the cartilaginous articular surface of the femur is displaced. In one case, I removed a portion of the cartilage, the size of a fifty-cent piece, from the inner condyle of the femur without touching the internal semilunar cartilage in which I had diagnosed a semilunar lesion. Sometimes a large calcified body is found in the knee under the quadriceps bursa. *This condition is not apparent in the roentgenogram although, as already referred to, if chronic and containing enough lime salts and osteoblasts, it will show.*

Incidentally, loose semilunar cartilages are not diagnosable by roentgen ray unless the knee is injected with oxygen, which is a dangerous procedure; whereas in osteochondritis they will show when in numerous quantities without oxygen ingestion. This helps in making a differential diagnosis.

TREATMENT. Surgical removal is the method of choice, the same technique being followed as that advocated by Sir Robert Jones in the removal of the semilunar cartilage (Fig. 385). The after-care and the complications are the same as those following removal of the semilunar cartilage.

PROGNOSIS. The disability period in uncomplicated cases lasts two and one-half or three months and is followed by no specific loss of function. I must again emphasize the importance, in handling these conditions, of having proper surgical training to do the work. If a surgeon has not had the proper training he is not justified in jeopardizing the outcome to the patient.

ACUTE RUPTURE OF THE CRUCIAL LIGAMENTS IN THE KNEE JOINT

This uncommon injury is produced by complete dislocation of the tibia on the femur, forward, backward or laterally. Sometimes a forcible backward snapping of the knee causes it.

SYMPTOMS. This injury causes immediate marked effusion into the knee joint. Objective evidence of a dislocation is marked. In diagnosing crucial rupture the knee is flexed at an angle of from 45° to 90° , with the foot resting on the floor or table. The examiner then grasps the shaft of the tibia with both hands, and manipulates the tibia backward and forward on the femur. If the crucial ligaments are ruptured, preternatural play exists, both backward and forward (Fig. 386). The roentgen ray is a valuable supplement to the symptoms in the making of a diagnosis, in eliminating fractures. Very often fracture of the tibial spine will complicate the condition; this is shown in clear roentgenograms.

TREATMENT. Conservative treatment consists in early application of a plaster cast from the foot to the thigh, with the knee in a position of 20° flexion, as advocated by Sir Robert Jones. This position is the best for rapid healing. The cast should be allowed to remain on for at least one to two months. Passive and active motion and massage are then begun. After removal of the cast, for the following two months the patient should not be permitted to walk or indulge in weight-bearing without the aid of a knee cage (Fig. 387). This appliance controls the lateral stability of the knee and at the same time limits flexion. It should be worn for at least six to eight weeks. At the end of this time, if there is no play at the joint,

the crucial ligaments can be considered healed. The physician can then help the patient to regain strength and stability by instructing him in the re-education of the quadriceps muscles. Voluntary con-

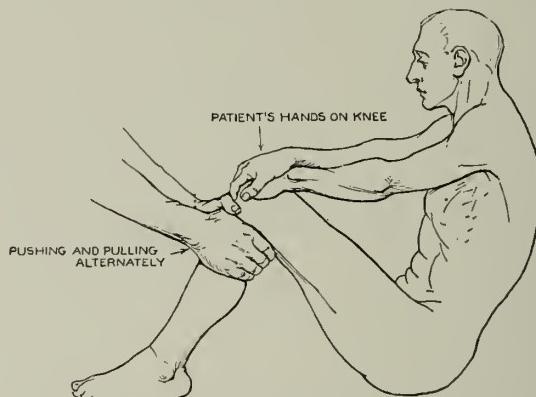


FIG. 386. Method of determining rupture of crucial ligaments of knee by pushing backward for anterior and forward for posterior crucial rupture.

traction of the quadriceps from the relaxed stage should be practiced as many times a day as possible with the limb in the position of extension. If this is done, the stability of the knee very quickly returns. Voluntary contraction is practiced with the patient standing upright, the affected limb held straight. In a month and a half to

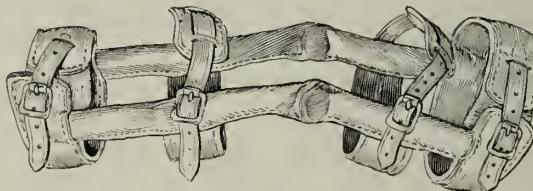


FIG. 387. Knee cage.

two months after beginning this re-education the patient can return to work.

It is claimed by some orthopedic men that the patient, through proper muscular education, can develop a compensatory function which obviates the use of the crucial ligaments altogether. In a patient employed in heavy manual labor I greatly doubt whether this is possible; first, because of the muscular atrophy that follows

this injury, and second, because heavy weight-bearing demands the use of the strong crucial ligaments. In this country we have never proved to our industrial commissions that such could be possible.

PROGNOSIS. The period of disability without operation extends over approximately four months. The prognosis must be guarded, however, since a chronic relaxed condition may establish itself, in spite of all non-operative attempts at healing (see the following section).

CHRONIC RUPTURE OF CRUCIAL LIGAMENTS IN THE KNEE JOINT

This much discussed condition commonly follows a dislocation of the knee, due to the fact that under the treatment described in the preceding section the crucial ligaments fail to heal.

TREATMENT. In one chronic case I repaired the anterior crucial ligament by means of an operation based on an anatomical study and tryout. In view of the fact that following the operation this man has been working steadily as a coal passer for two years with an almost perfectly functioning limb, the technique of this operation may be of help to other surgeons.

Preoperative Preparation. To begin with, prior to operation the physician should satisfy himself that the patient is a good surgical risk, because the operation consumes at least one and one-half and usually two hours. The patient, then, must be strong enough to withstand the strain of a long period under anesthesia.

On the night before operation the limb should be scrubbed from the thigh to the toes. It is then shaved and washed with soap and water, followed by plain water. Ether or alcohol is then used, and a mild bichloride dressing applied from the perineum down to the toes. This is left on all night. In the morning $\frac{1}{4}$ grain of morphine and $\frac{1}{150}$ grain of atropine should be administered half an hour before the anesthetic is given.

Operative Technique. This operation, in which the Lane technique is followed rigidly, is conducted entirely under the control of a tourniquet, so that it is practically bloodless. The limb should be painted with iodine followed by alcohol from the point of the tourniquet, which is applied at the upper and middle third of the thigh, down to the ankle. The limb must remain exposed from the line of the tourniquet to 4 or 5 in. below the patellar tuberosity of



FIG. 388. Fracture of spine of tibia with partial rupture of crucial ligaments, showing method of testing for rupture and repair without operation.

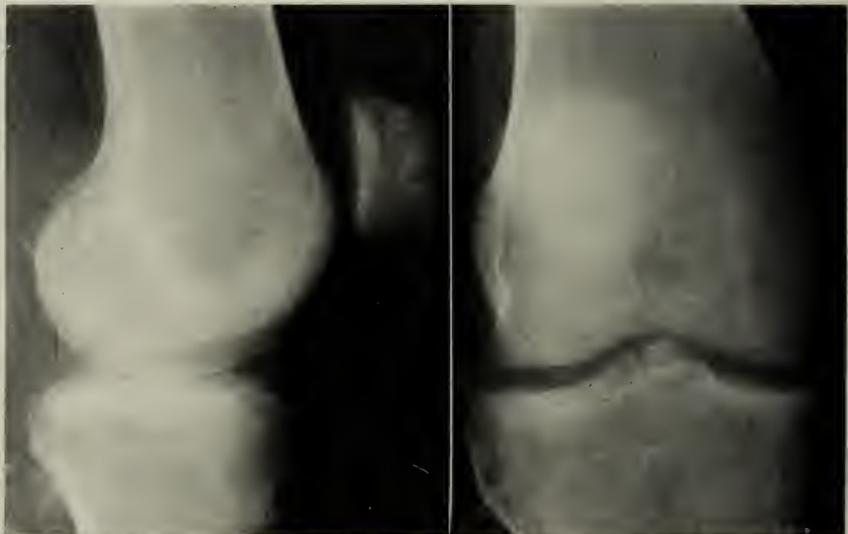


FIG. 389.

FIG. 390.

Figs. 389 and 390. Same case as Figure 388, showing fracture of tibial spine.

the tibia, in order that the incision may be carried around the insertion of the patellar tendon. The primary stage is done with the limb extended on the table; the remainder of the operation is carried out with the knee flexed over the end of the table (Fig. 391).

A lengthwise incision is made on the outer side of the thigh, extending from the junction of the middle and upper thirds down to the knee. It is then carried around and below the patella, to its inner side. This incision permits of subcutaneous dissection. The entire flap is turned back, thus allowing complete exposure of the fascia and the patella. The knee cap is sawed perpendicularly through to the inner surface. Upon reaching the inner surface a broad chisel is inserted and the inner surface of the patella fractured. An incision is made from the point of fracture upward through the quadriceps, a distance of 3 in. Another is made lengthwise from the lower margin of the fracture, extending downward in the patellar tendon toward insertion. The patella is drawn apart with retractors and the ligamentum mucosum severed. Occasionally one will find the ligamentum mucosum already ruptured and atrophied, in which event no further attention is necessary.

At this point the limb is dropped over the end of the table and flexed to a right angle. With the knee flexed the two fragments of the fractured patella naturally draw still farther apart. (In the first case on which I operated, I discovered at this point that the posterior crucial ligament had healed, but the two ends of the anterior crucial ligament were lying free in the knee joint.) A subperiosteal resection is done on the inner side of the tibia and also a subperiosteal resection under the cruraeus of the femur at the external condyle. By means of a Murphy drill a hole is made up through the inner head of the tibia, coming out through the long axis of the remains of the anterior crucial ligament. After retraction of the cruraeus, a hole is drilled on the outer side of the condyle of the femur, down to the long axis of the ligament. An incision is then made on the outer side of the thigh and a strip of fascia, about 10 inches in length and 1½ inches in width, is removed. A silk ligature with a carrier is attached to one end of this strip, and passed through the upper opening down through the axis of the ligament, coming out at the lower opening of the tibia. The limb is then flexed at an angle of 20°, a position which takes up the normal tension of the ligament leaving approximately

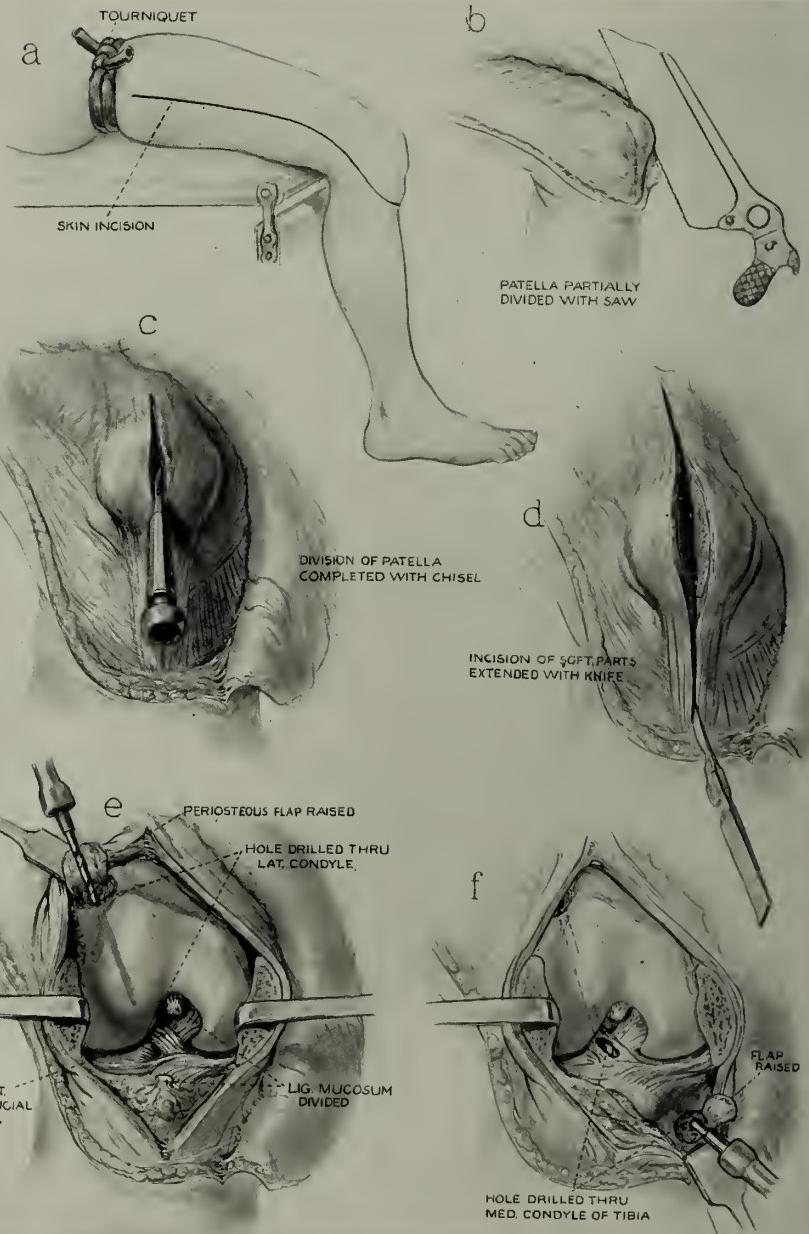


FIG. 391.

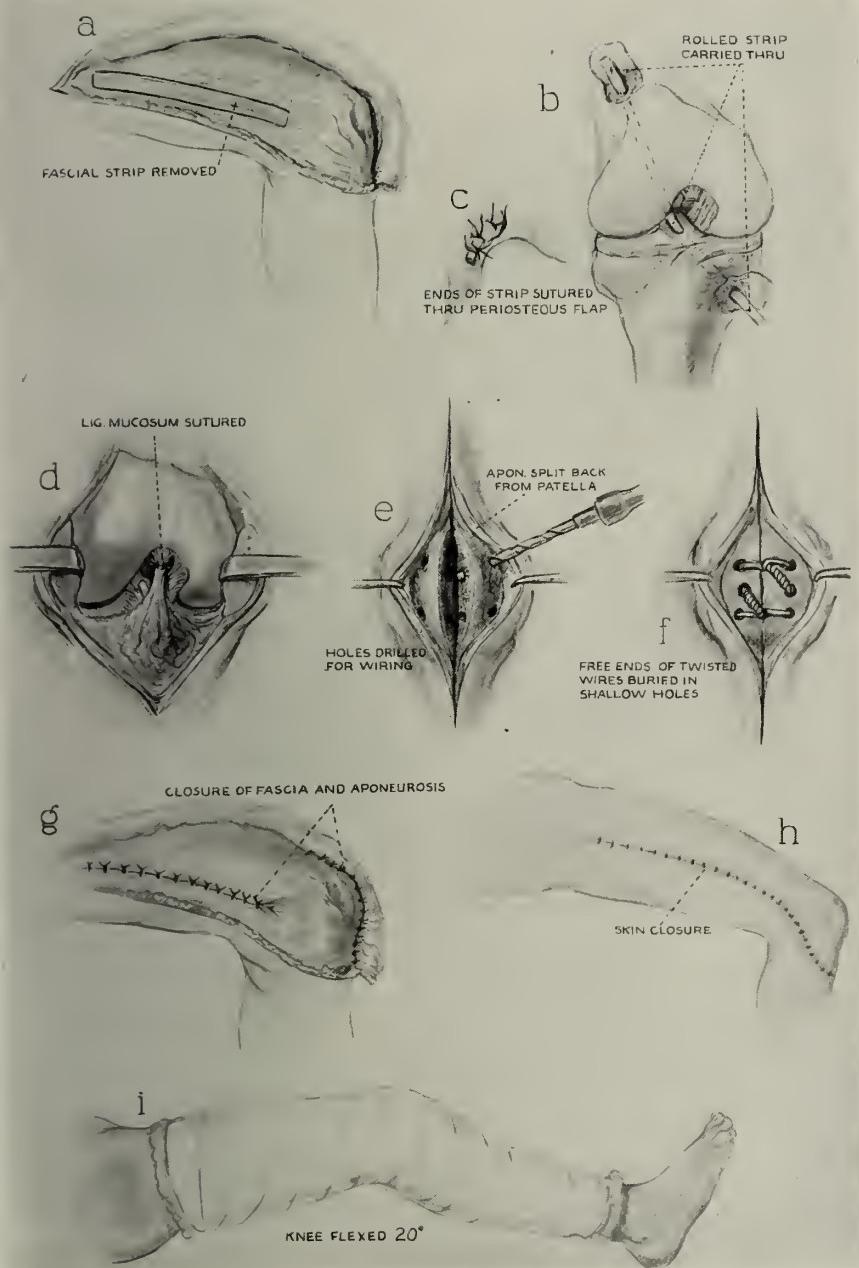


FIG. 392.

Figs. 391 and 392. Repair of anterior cruciate ligament of knee joint, author's technique.

an inch exposed at either end. The parts of the ligament left exposed are laid flat on the bone and can be either sutured to the periosteum or covered with a trap door of bone. The entire joint is now saturated

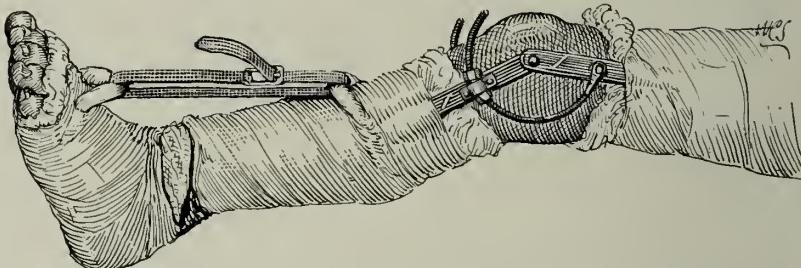


FIG. 393. Author's hinge-joint splint incorporated in plaster, for early motion in knee joint. Drawing also shows method of overcorrecting foot drop by strap traction after cutting cast at ankle.

with a combination of sterilized powdered iodoform combined with ether, using approximately 29.75 c.c. of the powder to 118.30 c.c. of the liquid. The cruraeus muscle is now sutured over the exposed ends of the false ligament. The periosteum of the condyle and the periosteum of the tibia are next sutured with No. 0 pyoktanin catgut. A No. 00 pyoktanin catgut is used to repair the ligamentum mucosum when necessary, and the patella is wired with two transverse wires. Since working out this operation and performing it on two other cases I have found it is not necessary to use wire in the patella, as a line of kangaroo in the aponeurosis is sufficient. The quadriceps and patellar aponeurosis are sutured with medium kangaroo tendon. The line of incision on the side of the limb is closed with No. 2 interrupted pyoktanin catgut, and the skin layer closed with interrupted silkworm sutures.

After the tissues are closed a plaster cast is applied from the thigh to the toes, with the limb still maintained in a position of 20° flexion. I wish particularly to emphasize that this is 20°. The cast should remain on for at least six to eight weeks followed by the wearing of a knee cage (Fig. 387) for two to three months together with quadriceps education.

In my first case, the patient returned to work three and one-half months after operation, and suffered no loss in his earning capacity. At the present time there is only very slight play in the knee joint.

The patient cannot flex his knee completely; he can flex it to an angle of something more than a right angle, and can extend it fully.

The first case operated on was in 1922, since which time 2 other such operations have been equally successful.

I do not offer this operation as a certain cure for every case of chronic rupture of the posterior and anterior crucial ligaments. All I can say is that it has brought about satisfactory results in the case of my patients. In view of the fact, however, that my first case has been kept under observation for three years, and now has a knee joint that functions very satisfactorily, I feel justified in describing the technique of the operation in order that other surgeons may at least give it a trial.

PROGNOSIS. Unless an operation such as is described above is employed for the relief of this condition, the patient suffers permanent functional disability. I seriously doubt whether, especially in patients whose work calls for much weight-bearing, the education of muscles that may compensate for the crucial ligaments can be successful. The operation described may, on further trial, be found to offer hope of a good functional result after a few months of post-operative treatment.

For the unhealed posterior crucial ligament, I am unable at this time to offer any operative solution. However, even where both anterior and posterior are ruptured and fail to heal, I feel sure that the building of an anterior crucial alone would be of significant assistance to the patient.

FRACTURE OF THE PATELLA

SYMPTOMS. In this condition immediately following injury there are present immediate disability (the leg cannot be extended on the thigh), pain, muscle spasm, definite exudative synovitis, crepitation with preternatural mobility of fragments and sometimes ecchymosis. The roentgen ray is a valuable supplement to these symptoms in diagnosis of the fracture.

TREATMENT. With only occasional exceptions, open operation is the form of treatment. The exceptions are those cases in which there is only slight fragmentation at the quadriceps or patellar segment without separation of the aponeurosis; or a fracture of a small fragment on one or the other side, as these cases show fracture



FIG. 394. Fracture of patella. The type that needs operation and early motion with knee splints.

FRACTURE RECORD					Case No. <u>66785</u>			
Name <u>J. J.</u>	Age <u>25</u>	Sex <u>M.</u>	Mr. S. W. B. -	Address <u>White and Collected</u>	Date <u>1-13-26</u>			
Occupation					Hospital Entered			
Cause of Fracture STRUCK RIGHT KNEE SHARPLY AGAINST TOOL BOX					First Treatment			
X-Ray No.					Final Reduction			
EXAMINATION		TREATMENT		RESULT				
Bone	Closed Reduction				Good Moderate Bad			
Site	Method and Position of Fixation				Anatomical Functional			
Type:	Anesthetic Used EITHER <u>yes</u> <u>No</u>				Description of End Result: including Deformity, Shortening, Function, Pain, Swelling, Nerve			
Simple	Traumatic					(a) At discharge from Hospital Date <u>2-23-27</u>		
Compound	Oblique	Anatomical Result obtained				DISCHARGED HOME WITH CRUTCHES		
Intra-Joint	Spiral							
Subluxation	Impacted							
Cross-Block	Comminuted	Open Reduction <u>1-26-26</u>						
Method and Position of Fixation SURGICAL REPAIR								
Description of Deformity (including shortening)					(b) At discharge from O. P. D.: Date			
OF PATELLA, PLASTER CAST.								
Anatomical Result obtained								
Nature and Extent of Injury to Soft Parts especially nerves and vessels								
Was non-operative treatment tried first?					(c) At subsequent date: Date			
How long after injury was operation performed?					Disability: Absent, Partial, Complete			
Was internal fixation material subsequently removed?					END RESULT UNKNOWN, CASE FAILED.			
X-Ray TRANSVERSE FRAC. THRU PATELLA					Mortality Date			
Before Reduction WITH MODERATE SEP. OF FRACTURES.					Main cause of death			
After Reduction FRACTURES.					Absence from work: Duration			
At Discharge					Ability to resume job			
Nassermann Test					Present Wage earning capacity			
Total Period of Prosthetic Treatment					Compensation obtained: Yes? No?			
					*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion			

Form 19 (A.C. 3 Case Record System
Futura Company, Chicago)

FIG. 395. Fracture record of case shown in Figure 394.

within the capsule unaccompanied by separation. In these cases an adhesive basket weaving provides all necessary support or where there is much synovitis a cast with knee splints. The limb is immobilized for two and one-half to three weeks. Active and passive motion may then be begun, and three weeks after injury weight-bearing may be started continuing adhesive support up to six to eight weeks or even until swelling subsides. Six to ten weeks after injury complete weight-bearing may be attempted, and two and one-half to three months after injury, the patient should be able to return to work and should be entirely free of any stiffness in the knee.

Operative Treatment. There are many operative methods of treating fracture of the patella; but before attempting any of them the knee should be immobilized and treated with hot and cold applications for at least ten days to two weeks. Early operation is liable to cause infection or to be followed by a breaking-down of the tissues.

The type of incision chosen is important. A semicircular incision running around the outer side of the knee (Fig. 402) is preferable to the old horseshoe incision for two reasons: First, since it runs parallel to the long axis of the limb, it does not interfere with the venous circulation and so does not cause postoperative swelling, and thus averts not only a longer disability due to an edematous leg, but also the added expense of an elastic stocking. Second, since it lies to one side of the patella there is no danger of irritating it when the patient, whose occupation may call for considerable kneeling, assumes a position that brings the patella in contact with a hard substance. Thus the possibility of a painful scar and keloid formation is avoided.

Incidentally, in operating upon these cases I make it a point to remove the prepatellar bursa entirely before exposing the fracture.

The method of fixing the patella is a matter of preference. I have followed the method of fixation with silver wire for a number of years, and shall continue it in view of the success I have obtained, not only in the primary operation, but in the end-results. Even when there is a comminution or multiple fracturing of the patella, one can still apply the wires in a manner that will give good approximation. Occasionally, however, I remove fractured portions of the patella in cases in which I think the development of too much callus will interfere with joint action. Occasionally I am asked why I use wire

when kangaroo tendon is just as good. It is not as good, for it does not permit as early motion as wire fixation, and separates more easily by slight trauma. For instance, in a case of double fracture of the



FIG. 396.

FIG. 397.

Figs. 396 and 397. Fracture of patella, comminuted type which does not need operative correction or fixation. Patient treated by plaster cast with hinge-joint splint incorporated at knee so that early motion was obtained. (See chart, Fig. 400.)

patella (Figs. 396-400) the patient, while walking in the hospital, six weeks after operation, slipped and fell, striking his left knee on the concrete floor. The chances are that with a kangaroo suture, separation would have taken place, whereas in this instance no separation occurred.

The surgeon should follow strictly the Lane technique of asepsis, using a tourniquet and even tying the sutures with forceps. This may sound difficult, but with a little practice one can soon learn to tie the sutures with forceps as easily and even faster than with the fingers.

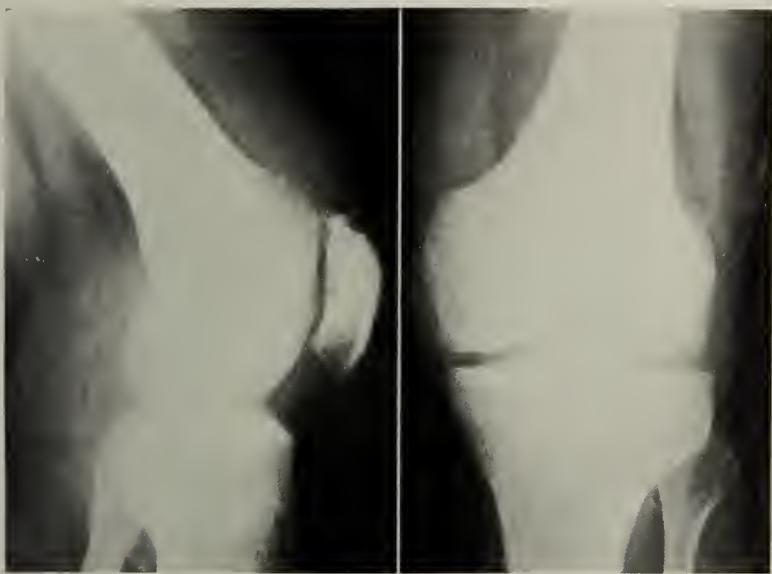


FIG. 398.
FIGS. 398 and 399. Same case as Figures 396 and 397.

FRACTURE RECORD																							
Name	W.B.	Address																					
Age 26	Sex M	M F	M S W B	White-as-Evidence	Time of Occurrence of Accident 10-17-27																		
Occupation LABORER					Hospital Entered WEST SIDE																		
Cause of Fracture FELL ABOUT 20 FEET LANDING ON LEFT KNEE					First Treatment 10-19-27																		
					X-Ray No 33030	Final Reduction																	
EXAMINATION			TREATMENT			RESULT																	
Bone PATELLA - LEFT			Closed Reduction			<table border="1"> <tr> <td colspan="3">Anatomical</td> <td>Good</td> <td>Moderate</td> <td>Bad</td> </tr> <tr> <td colspan="3">Functional</td> <td>X</td> <td></td> <td></td> </tr> </table>						Anatomical			Good	Moderate	Bad	Functional			X		
Anatomical			Good	Moderate	Bad																		
Functional			X																				
Site			Method and Position of Fracture PLASTER CAST TO LIP, KNEE 5 DEGREES FLEXION.																				
Type:			Anesthetic Used Yes No																				
Style			Anatomical Result obtained																				
Compound																							
Joint																							
Subperiosteal																							
Genuick																							
X Comminuted			Open Reduction																				
Description of Deformity including shortening			Method and Position of Fracture																				
EXTENSIVE SWELLING WITH ABRASIONS ABOUT KNEE.			10-31-27, SECOND CAST WITH HINGE JOINT SPLINT INCORPORATED AT KNEE FOR MOTION.			Description of End Result, including Disability, Shortening, Function, Pain, Swelling, Nerve. (a) At discharge from Hospital, Date 10-21-27 LED IN CAST - THIGH TO ANKLE.																	
Nature and Extent of Injury to Soft Parts especially nerves and vessels						(b) At discharge from O.P.D., Date 2-4-28 KNEE MOTION, LIMIT 20 DEGREES FLEXION, EXTENSION COMPLETE, ENLARGEMENT 5/8 in. OVER PATELLA, ATROPHY 3/4 in. OVER CALF.																	
NO BLOOD VESSEL OR NERVE INJURY.			Was non-operative treatment tried first?			Disability: ABSOLUTE, 100% LOSS OF MOTION, 50% FUNCTIONAL LOSS IN LED.																	
			How long after injury was operation performed?																				
			Was internal fixation material subsequently removed?																				
X-Ray			When			Mortality Date																	
Before Reduction SHATTERED FRACTURE						Main cause of death																	
After Reduction			Period of Complete Immobilization 1 MONTH			Absence from work: Duration 16 WEEKS																	
At Discharge			Period of Protection 3 WEEKS			*Ability to resume job																	
Wassermann Test NEGATIVE			Total Period of Protective Treatment 7 WEEKS			*Present Wage earning capacity SAME Compensation obtained: Yes? X No?																	
										*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion													

Form 19/A C & B Case Record System
The Brown Company, Chicago

FIG. 400. Fracture record of case shown in Figures 396 to 399.

After exposing the patella by a curved longitudinal incision down to, then through, the aponeurosis, and after studying the nature of the fracture, I introduce silver wire through the outer



FIG. 401. Fracture of patella of type requiring operation of perfect function of quadriceps tendon.

shell of the patella, obtaining a four-point fixation of the bone, as shown in Figure 402, and bury the ends of the wire in the patella, as shown in Figure 403. I make it a point to remove the prepatellar bursa, thus obviating the possibility of a postoperative prepatellar bursitis, as referred to above.

The patella having been wired and, if necessary, the synovial membrane repaired a solution consisting of 14.78 c.c. iodoform and 118.30 c.c. ether is poured into the field and then dried out, leaving a faint film of iodoform and ether in the tissues. The question of what solution to use is a matter of choice, based on the surgeon's experience. For those who have not had much experience in this type of surgery, the solution mentioned will be found to be very satisfactory. Absolute Lane technique can be acquired only by practice.

The aponeurosis is closed with medium-sized kangaroo tendon sutures. There are cases in which the synovial membrane on one or both sides of the patella is torn. In these cases, it is advisable to

repair the synovial membrane, using preferably No. 1 pyoktanin, or else plain catgut.

A posterior molded plaster shell is applied extending from gluteal fold to ankle, with the knee in a position of 10° flexion. Plenty of padding is placed over the patella and the knee is immobilized until the sutures are removed on the seventh or eighth day after operation. Gradual passive motion is then begun and performed every other day, removing the shell, then replacing it for three to four weeks, depending upon the age of the patient, the extent of fracture and the rate of healing. It is advisable in some cases where there is severe comminution or friability of bone, to wait two to three weeks before beginning motion.

The advantage of using silver wire is that motion may be begun at the end of seven or eight days, and continued until the patient is discharged with a perfectly functioning limb. Furthermore, in an injury of this type, there is bound to be a certain amount of muscle spasm, and when kangaroo tendon or some similar substance is used, a sudden involuntary contraction of the muscles may pull the sutures apart. The use of silver wire prevents such an accident following muscle spasm or during early passive motion.

Following operation there is always more or less atrophy of the quadriceps muscles. It is advisable, aside from using massage and passive and active motion, to educate these patients to contract their quadriceps muscle continuously, beginning about the fourth or fifth week after operation, by drawing the knee-cap up, in such a manner that the muscles will regain their volume and strength.

COMPLICATIONS. Sometimes there is a prolongation of the exudate, originally caused by the trauma, within the synovial sac of the knee joint. In such a case it is advisable to apply an elastic stocking, preferably from the toes to above the knee. This, together with exercise of the quadriceps, will help absorb the exudate. Occasionally, when surgical technique is incorrect, an infection of the knee joint occurs, in which case the disability period is materially prolonged. Occasionally a focal condition, such as infected teeth or tonsils (in one case in my practice, typhoid) may cause such a complication as postoperative osteomyelitis.

PROGNOSIS. The total disability period extends over three months and the partial disability over another month and a half to two months.

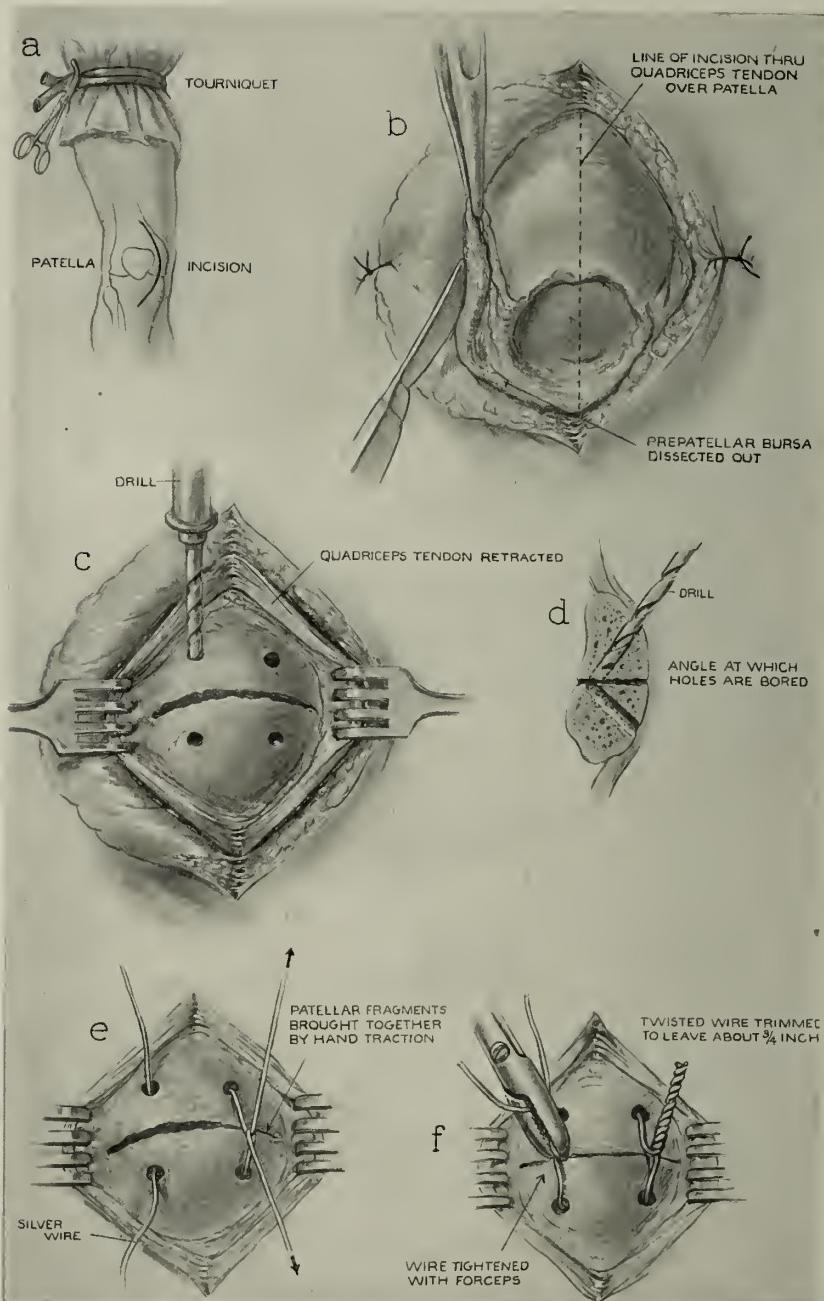


FIG. 402. Surgical repair of fractured patella.

RUPTURE OF QUADRICEPS TENDON

This is an uncommon condition but one which causes an immediate disability. It is brought about by a sudden tension on the quadri-

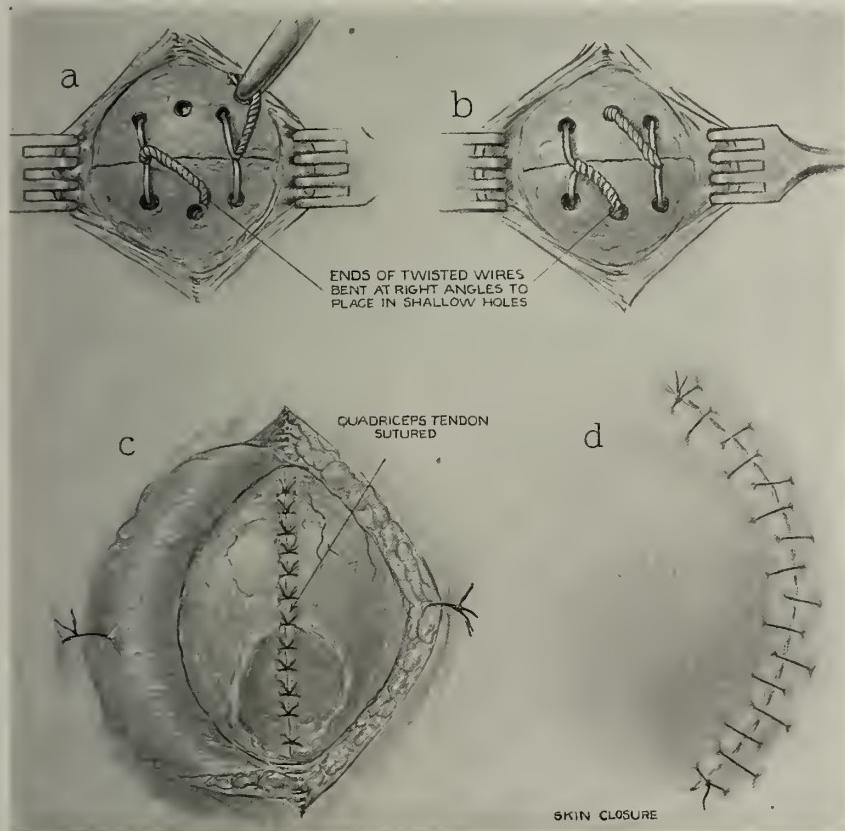


FIG. 403. Operation shown in Figure 402, continued.

ceps through some involuntary action. It occurs, as a rule, in people of advanced years whose bones and tissues are brittle and friable.

It is caused usually by a sudden slipping on an icy pavement or stepping down from an elevation, such as from a chair to the floor, in which the chair in some manner gives way, producing a snapping strain on the muscles of the thigh.

SYMPOTMS. The symptoms are immediate disability, inability to walk, severe localized pain calling for anodynes, swelling, effusion,



FIG. 404.



FIG. 405.

FIGS. 404 and 405. End-result after open operation in fracture of both patellae where considerable separation existed, using author's technique.

FRACTURE RECORD										
Name	C. W.	Address			Case No.	76104				
Age	23	Sex	M	W. S. W. D.	Date	12-2-25				
Occupation	CARPENTER			Time of Occurrence of Accident		12-2-26				
Cause of Fracture	FELL 3 FLOORS			Hospital Entered		12-2-27 W. S. Hospital				
				First Treatment						
				Final Reduction						
EXAMINATION				TREATMENT				RESULT		
Bone PATELLA RIGHT AND LEFT				Closed Reduction				Good	Moderate	Bad
Site: KNEE				Method and Position of Fixation				X		
Type:				Anesthetic Used				X		
Simple				Yes						
Compound				Anatomical Result obtained						
Into Joint										
Subperiosteal				Functional						
Grenwick				X						
Commissum				RT. PATELLA						
Description of Deformity (including shortening)				Open Reduction				Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve		
SWELLING AND DISCOLORATION BOTH KNEES				Method and Position of Fixation				(a) At discharge from Hospital Date 2-1-27		
				PATELLAS EXPOSED AND WIRED				SOME SWELLING ABOUT KNEES, MOTION ALMOST COMPLETE. KNEES VERY WEAK.		
								(b) At discharge from O. P. D. Date		
Nature and Extent of Injury to Soft Parts especially nerves and vessels				Anatomical Result obtained				Very Good		
LACERATIONS SCALP, BRUISES, SWELLING AND DISCOLORATION KNEES										
X-Ray										
Before Reduction				Fractures PATELLAS				Mortality		
				When				Date		
After Reduction				GOOD APPROXIMATION				Was non-operative treatment tried first? NO		
				Period of Complete Immobilization				Disability: Absent, Partial, Complete		
At Discharge				3 WEEKS						
				Period of Protection				How long after injury was operation performed? 2 WEEKS		
Wassermann Test				8 WEEKS				Was internal fixation material subsequently removed? NO		
NEGATIVE				Total Period of Protective Treatment				Ability to resume job		
				12 WEEKS				Present Wage earning capacity		
								Compensation obtained: Yes? No?		
								Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion		

Form 15/A.C.B. Case Record System
Futura Company, Chicago

FIG. 406 Fracture record of case shown in Figures 404 and 405. Patient was able to resume old job with same wage capacity.

fluctuation, inability to extend the leg from the knee. By palpation there is found in addition preternatural mobility but not always crepitation. A roentgenogram assists materially and particularly if it is made with the idea of showing soft parts as well as bone. A simple fracture of the patella is obvious as it shows a definite solution of continuity of bone substance, but in this lesion a retraction of the quadriceps and a well-marked dark area between the upper border of the patella and the tendon substance are seen.

TREATMENT. Naturally, if one sees this case immediately, he should be conservative in his treatment by first applying a posterior splint of some kind to prevent flexion until he can get the patient to bed. This should be a hospital bed where adequate treatment and observation can be carried out.

After the diagnosis has been made one should not hesitate to advise operation, but not until the case is ten days to two weeks old. I may be criticized for making this statement without reservation in regard to operation, but I am of the firm opinion that any injury sufficient to produce such a separation produces a tear complete enough to demand repair by open operation. This only will give a repair *sufficiently strong to produce an efficient working limb*. I do not now refer, of course, to the case that is not a good surgical risk.

Keep in mind in doing the operation that usually the violence has been sufficient to tear the capsule on one or both sides of the tendon. Be sure to inspect the capsule also, as it may be necessary to close it with a No. 1 plain catgut or pyoktanin catgut suture before repairing the quadriceps, as I have had to do in a number of cases. I cannot lay enough emphasis on the technique in doing this work; it all should be accomplished with instruments only, even to the tying of knots, and with the greatest possible observation of scrupulous asepsis. *All sutures should be interrupted sutures.*

Following repair I use the ether and iodoform combination referred to previously, then close the outer tissues and apply a plaster cast extending from the ankle to the groin, with the knee in 10° flexion. The cast should be left on for at least three weeks; then, instead of resorting to passive or active motion, I place pillows under the knee, gradually increasing them, thereby obtaining flexion without pain or tearing of tissues. The patient should lie in bed during this form of treatment, usually six to eight weeks. There should be no weight-bearing for two months, and then only with crutches.

COMPLICATIONS. Complications are septic fibrosis from local infection following faulty technique; occasionally joint fibrosis from focal infection in remote parts of the body.

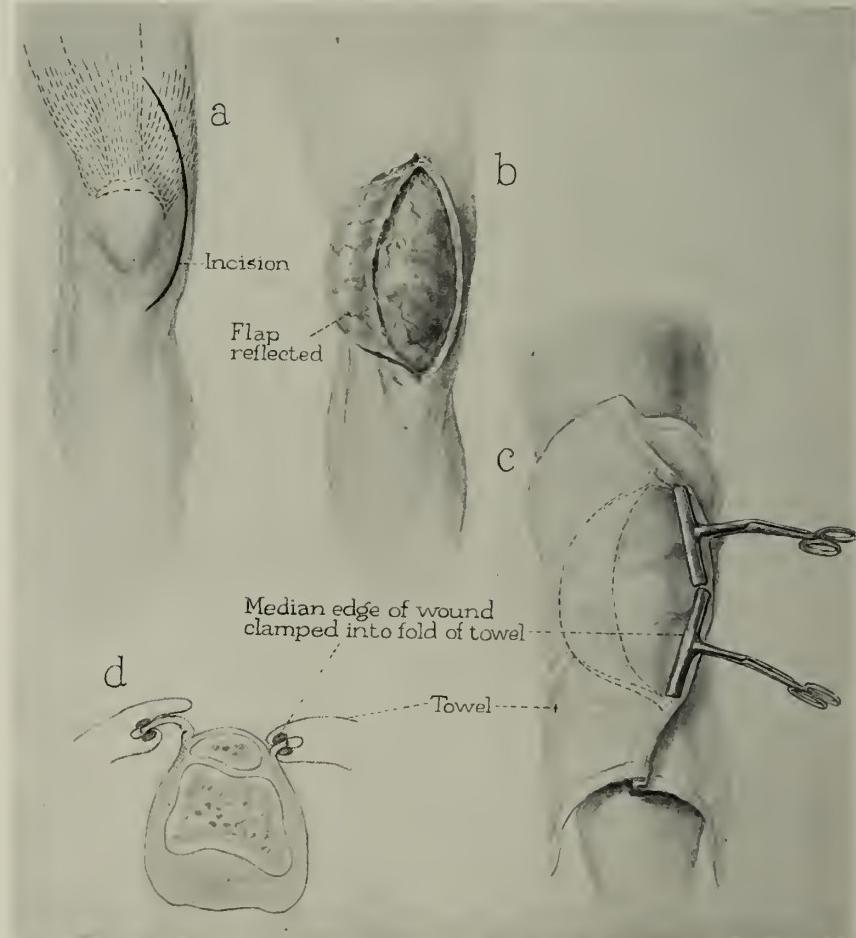


FIG. 407.

PROGNOSIS. Disability will be five to eight months depending upon the nature of the patient's occupation.

CHRONIC SLIPPING PATELLA

SYMPTOMS. This condition, which is usually accompanied by some pain, is caused by a dislocation of the patella, sometimes upon the

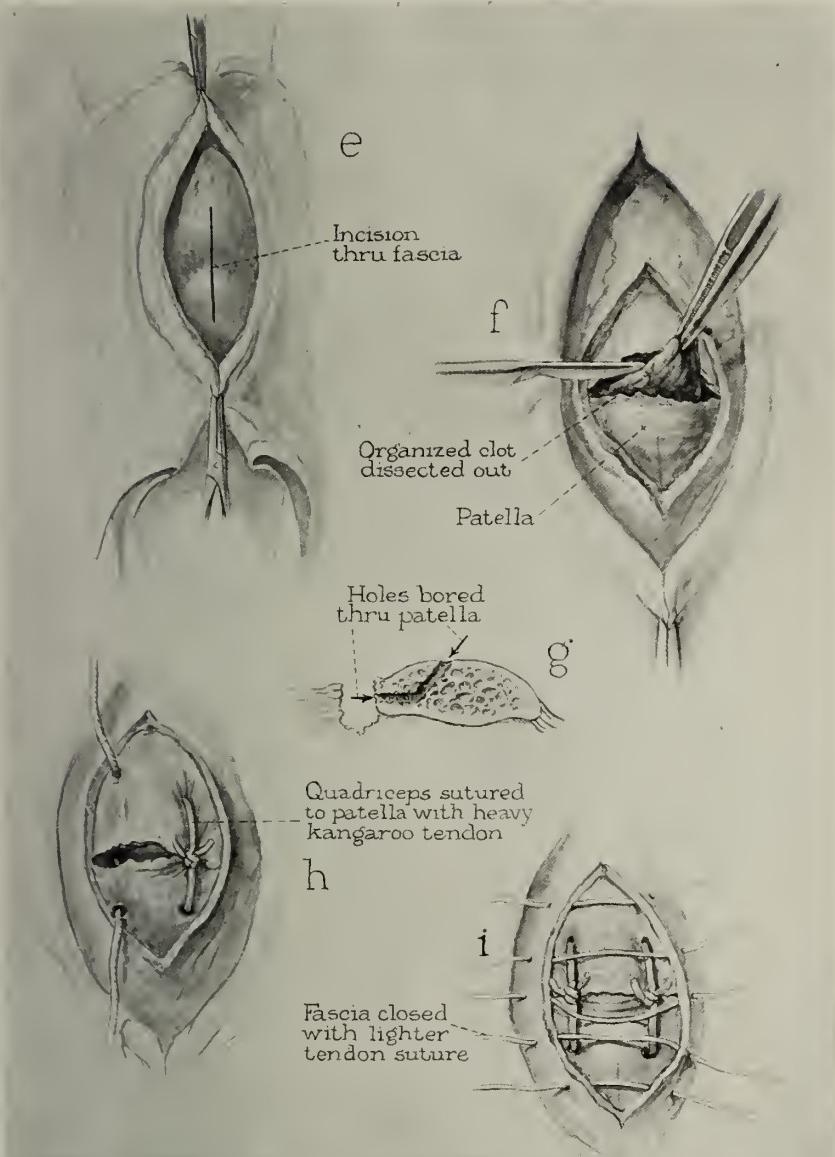


FIG. 408.
FIGS. 407 and 408. Operation on ruptured quadriceps tendon.

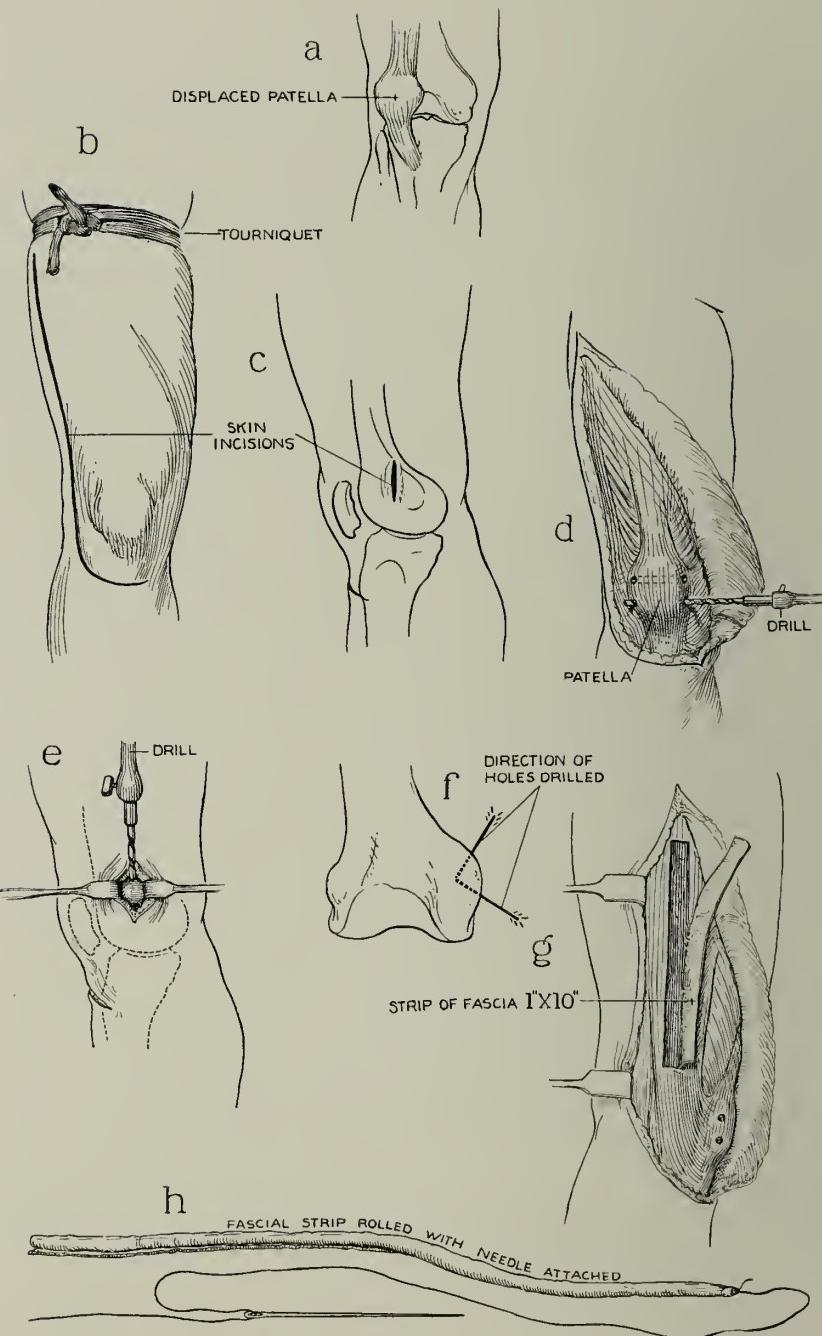


FIG. 409

[308]

slightest provocation. While walking on rough and sometimes even on level ground, there may be a sudden, unexpected flexion of the knee, and the patient falls. This may be due to weak quadriceps,

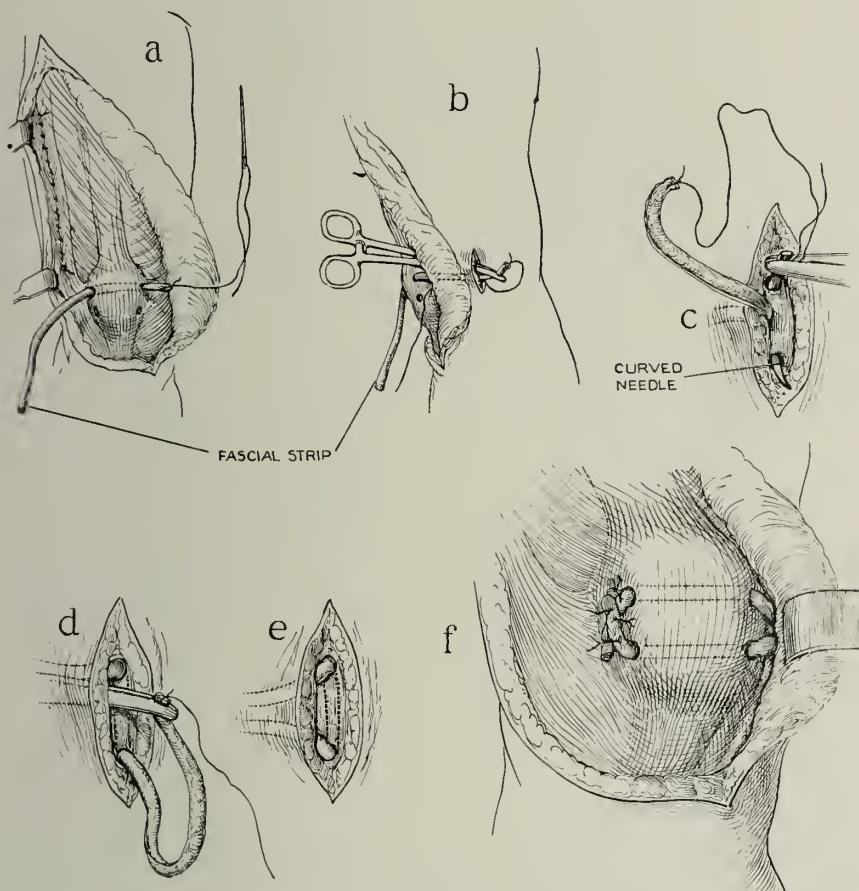


FIG. 410.
FIGS. 409 and 410. Repair of chronic luxation of patella.

congenital bone defect or trauma from a sudden twisting motion followed by sitting on the leg.

When examining the patient the slipping of the patella can be easily observed by having him sit on the edge of a table with the limb extended. Upon flexion at the angle of about 15° , the

patella slips over to the outside of the knee. When the limb is again extended, the patella slips back into its normal position.

TREATMENT. The only treatment of this condition is surgical. Gallie has previously published a similar technique.* The operation which I use (Figs. 409 and 410) embodies the following points:

The Lane technique of asepsis, including the application of a tourniquet, is observed throughout the operation. The large flap incision which allows complete exposure of the patella is preferable because the drill holes may then be properly spaced and lined up through the patella. The incision is made on the outer side of the thigh from the junction of the middle and upper thirds down to the external condyle and around to patellar insertion or a little beyond, to allow turning over of the flap. A 1 inch incision is made over the internal condyle, reaching down to the bone. Two horizontal holes are drilled longitudinally, about 1 inch apart, through the bone substance of the patella. Two holes are then drilled at right angles in the internal condyle of the femur, making a loop in the bone. A strip of fascia, at least 12 inches long and $\frac{3}{8}$ inch wide, is then removed from the thigh. It is rolled in the form of a cigarette and a silk suture with a carrier is attached to one end. This is passed through the upper hole drilled in the patella, then looped through the hole in the condyle of the femur, and carried back to the lower hole drilled in the patella, thus making a complete loop from the patella to the condyle. The patella is then forced to the inner side, thus being placed in a position of overcorrection as compared to normal. The two exposed ends of the fascia are sutured together and then to the periosteum of the patella. The fascia on the thigh is closed with No. 1 pyoktanin catgut interrupted sutures. A large dressing is then applied to the knee and, with the knee in a position of 5° flexion, a plaster cast is applied.

The cast should be left on for about six weeks. After its removal, passive massage should be used for a week or so with gradual weight-bearing with crutches. These patients can usually dispense with crutches within two to four weeks.

* Gallie, W. E., and Lemesurier, A. B. Transplantation of fibrous tissues in repair of anatomical defects. *Brit. J. Surg.*, 1924, xii, 289; Habitual dislocation of patella. *J. Bone & Joint Surg.*, 1924, vi, 575.

See also Albee, F. H. Orthopedic and Reconstructive Surgery. Saunders, Phila., 1919, p. 624.

PROGNOSIS. There will be three to four months' disability with complete recovery.

TRAUMATIC SYNOVITIS

Traumatic synovitis is caused by either direct or indirect violence to the knee joint, resulting in increased exudate within the synovial capsule which produces marked effusion.

SYMPTOMS. The symptoms include swelling, pain, limitation of motion and fluctuation on palpation. Tuberculous synovitis, affections of the semilunar cartilage and acute arthritic conditions may cause symptoms of a similar nature; hence a diagnosis must be made with care. Roentgenograms, anteroposterior and also lateral, rule out fracture.

TREATMENT. The treatment consists either in the application of a plaster cast, with the knee immobilized in a position of 10° flexion for a period of four to six weeks followed by gradual massage and the wearing of an elastic stocking; or (and this is the method I prefer), the immediate application of basket-weave adhesive molded about the knee as shown in Figure 412, and at the same time instruction of the patient in the contraction of the quadriceps muscle. Either of these methods brings about absorption of the excess fluid. Pieces of sponge rubber cut to the outline of the capsule and bandaged are very efficacious.

I do not believe in tapping the knee joint, as it tends to increase the disability and predisposes to infection. Immobilization with extension is not necessary, but it is much to be preferred to tapping. In very many of these cases the patient can continue at work. Occasionally a stubborn case will be encountered, calling for complete rest, strapping or plaster cast. I do not think diathermy accomplishes the results claimed for it in these cases.

PROGNOSIS. After the application of adhesive, and if contraction of the quadriceps is practiced, these patients may, in the majority of cases, continue to work. In the course of six to eight weeks, absorption will be complete. Prognosis, however, must be guarded, since in some cases the condition is aggravated by the presence of focal or persistent systemic infections or gradual change to malignancy such as tuberculosis, Charcot joint, etc.



FIG. 411.



FIG. 412.

FIGS. 411 and 412. Method of strapping knee to check motion in acute synovitis and give tight support. Prevents skin irritation when used for long periods. Beneath strapping is layer of plain gauze bandage.



FIG. 413.



FIG. 414.

FIGS. 413 and 414. Infrapatellar bursitis, lateral and anteroposterior views.

PREPATELLAR BURSITIS

Prepatellar bursitis (housemaid's knee) is a condition brought about by direct trauma. It occurs commonly in people who have to work on their knees, as carpenters, scrubwomen, etc.

SYMPTOMS. There is marked swelling, about the size of a small orange, on the outer side of the patella, accompanied by fluctuation, a condition indicative of fluid in the sac.

TREATMENT. Surgical removal of the sac is the only satisfactory method of treatment. This can be done under local anesthesia, using a 2 per cent solution of novocaine. A semicircular incision should be made for approach.

Removal of the sac materially cuts down the disability period; in cases treated by non-operative measures the disability period may last for months. Occasionally when the swelling is slight, strapping such as is used in synovitis will suffice. Sometimes this is the only method because of the patient's refusal of surgical interference. Nothing is to be gained by incision and drainage, or by aspiration of the fluid contents. If these methods are followed, the sac is subjected to the possibility of infection. If infection does develop, it is likely to continue indefinitely as a chronic infected sinus.

PROGNOSIS. If properly treated surgically, the disability period will last four to eight weeks at most, with no specific loss of function following treatment. Usually when the sac is surgically removed and no infection follows the disability will be three to four weeks.

CHAPTER XV

INJURIES OF THE TIBIA AND FIBULA

FRACTURE OF THE HEAD OF THE TIBIA

WHEN the injury is sufficient to produce a fracture of the head of the tibia, as a rule it causes some comminution of the bone. Occasionally one or both tuberosities are broken off and sometimes the bone is impacted. The joint surface is almost always involved.

SYMPTOMS. The symptoms include pain, muscle spasm, occasionally crepitation and marked effusion into the knee joint (synovitis). The patient is unable to walk. A definite change in contour occurs as compared with the normal limb: angulation at the knee joint, with either an inward or an outward bowing. Roentgenograms are an excellent supplement to these symptoms in the making of a diagnosis.

TREATMENT. I have simplified the treatment of this injury to just one method. In Figure 415 are shown a pair of splints which I have devised for the treatment of this type of fracture, as well as for treatment of intercondylar fracture of the femur. As a rule, for the first week or ten days, rest, hot or cold applications and immobilization of the limb in a position of 10° flexion until the effusion in the knee joint subsides are the only therapeutic measures necessary. If, however, there is very much displacement, an extension can be applied below the knee for a week or ten days to bring the bones into alignment. Then a plaster cast is applied from the toes up to the inguinal line, or as near to the perineum as possible. This cast should be applied with sufficient cotton wadding underneath to avoid any pressure spots and should cover the entire limb to a depth of about two layers. The splints are incorporated in the plaster in such a way that the hinged parts of the splints come *directly opposite the condyles of the femur*. The flanges of the splint are incorporated in the plaster, and the entire apparatus allowed to harden, with the limb in a position of 10° flexion. While the plaster is still soft about the knee, a semicircular section is removed from the front and back of the cast, completely exposing the knee joint and popliteal space. Motion may

be instituted as early as seventy-two hours after the application of the cast.

This splint possesses the double advantage of holding the limb

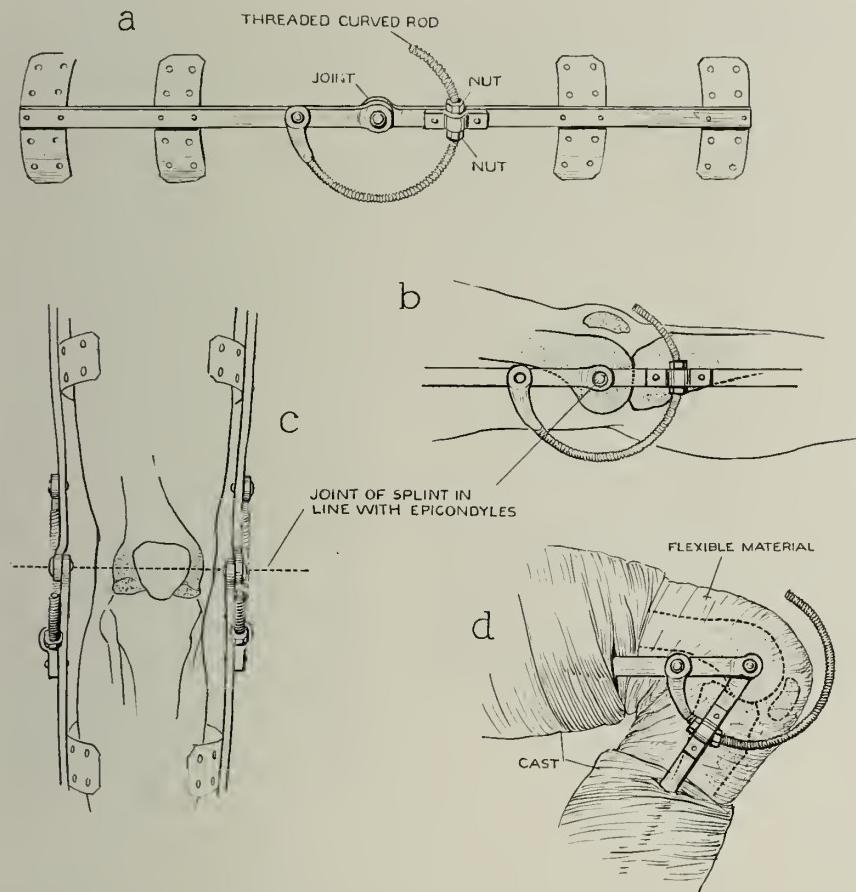


FIG. 415. Author's knee splint for fractures of condyles or head of tibia into joint, showing application.

in position and allowing early motion, and also molding the callus thrown into the knee joint, at the same time permitting extension and flexion at the knee.

Emphasis should be laid on one point: as in fractures of the condyle of the femur, upon instituting motion, extension should

be exerted on the splint, so as to have the limb brought out to a perfectly straight line. The limb should be placed in the position of full extension *every night*, in order to mold any callus out of the



FIG. 416.



FIG. 417.

FIG. 416. Case showing gratifying results treated by Dr. Robinson. Note extent and displacement.

FIG. 417. Same case as Figure 416, showing knee splint in place with reduction.

anterior chamber of the knee joint. In the meantime, gradually increasing flexion may be resorted to every day.

One of the simplest ways of obviating any subsequent locking of the knee is to allow the patient to work the splint during the day and gradually to obtain as much flexion as possible, and at night to put the limb in the position of full extension and leave it in that position until morning. If this is done every night, there is little or no



FIG. 418.



FIG. 419.

FIGS. 418 and 419. Fracture of inner condyle of femur and head of tibia. Knee splints applied. For end-result see chart (Fig. 420).

FRACTURE RECORD							
Name	F.P.	Address	X658 INDIANA AVENUE			Case No.	33831
Age	35	Sex	M	White or Colored		Date	12-5-21-Hr.
Occupation	KATCHMAN					By	FORRESTER
Cause of Fracture	GUN SHOT WOUND						
				X-Ray No.	13306		
EXAMINATION				TREATMENT		RESULT	
Bone RIGHT FEMUR AND TIBIA				Closed Reduction		Good	Moderate
Site RIGHT KNEE JOINT				Method and Position of Fixation		Bad	
Type				PARTIAL IMMOBILIZATION KNEE SPLINTS		Anatomical	
Simple	Transverse	Anesthetic Used	Yes	No	Functional	X	
Compound	<input checked="" type="checkbox"/> Oblique	Anatomical Result obtained					
<input checked="" type="checkbox"/> Intra Joint	Spiral					(a) At discharge from Hospital Date 1-25-22	
Subarticular	Incurved					SLIGHT GENU VALGUS	
Greenstick	Comminuted	Open Reduction				SLIGHT ENLARGEMENT OF KNEE	
Description of Deformity including shortening				Method and Position of Fixation		LIMITATION TO EXTENSION 10%	
						LIMITATION TO FLEXION 15%	
						(b) At discharge from O.P.D. - Date	
Nature and Extent of Injury to Soft Parts especially nerves and vessels				Anatomical Result obtained			
						(c) At subspecialist date Date	
						Disability: <input checked="" type="checkbox"/> Partial Paralysis 15%	
Was non-operative treatment tried first?							
How long after injury was operation performed?							
Was internal fixation material subsequently removed?							
On Day	Who	Mortality	Date				
Before Reduction	When	* Max. rev. of death					
After Reduction	Period of Complete Immobilization	Absence from work: Duration					
At Discharge	Period of Protection	Ability to resume job					
Wassermann Test	Total Period of Protective Treatment	Present Wage earning capacity					
		Compensation obtained: Yes? No?					
Form 194 (A.C.S. Case Record System) Fifth Edition, January, 1944				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion			

FIG. 420. Fracture record of case shown in Figures 418 and 419.

chance of limitation in full extension. There are other forms of treatment for this fracture, such as immobilization in a plaster cast, and passive and active manipulation by the surgeon; but they do



FIG. 421.

FIG. 422.

Figs. 421 and 422. Suitable case for knee splints. Full motion obtained.

not produce the satisfactory results obtainable with the splint described above.

The splint can be made by any mechanic at a nominal cost. It is allowed to remain on for two to two and one-half months, depending upon the age of the patient. At the end of this time no passive or active motion, massage, hydrotherapy or diathermy are needed. All the patient has to do is to regain confidence in his weight-bearing ability and develop his muscle tone and strength.

COMPLICATIONS. If there is fracture of the tibial spine, as shown by the roentgenogram, one or both crucial ligaments may be ruptured. In such a case the disability period is indefinitely prolonged. In rupture of the crucial ligaments motion should not be started until three weeks after application of the cast. Traumatic arthritis,



FIG. 423.



FIG. 424.

Figs. 423 and 424. End-result of comminuted fracture of head of tibia into joint and use of knee splint. Note position of weight-bearing line.

Fig. 425. Fracture record of case shown in Figures 423 and 424.



FIG. 426.

FIG. 427.

FIGS. 426 and 427. Comminuted fracture of head of tibia involving knee joint.

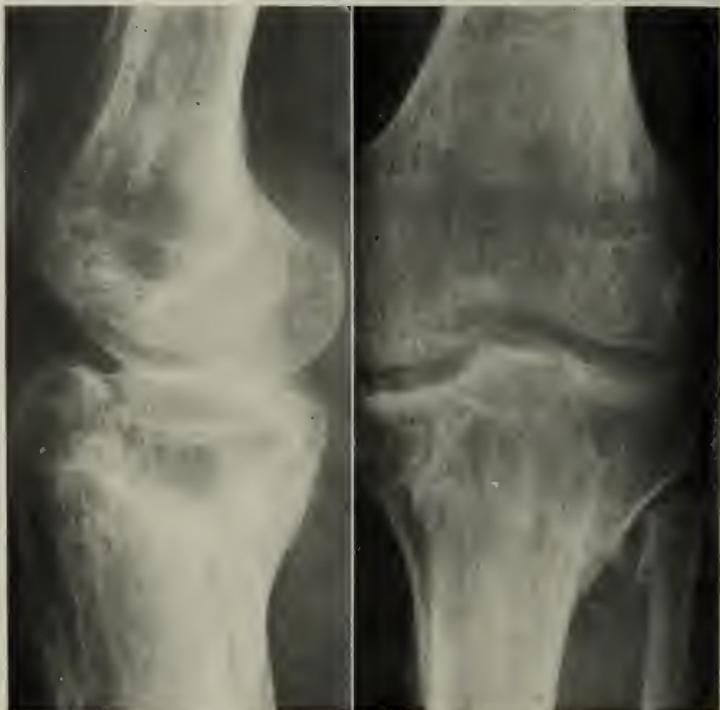


FIG. 428.

FIG. 429.

FIGS. 428 and 429. Same case as Figures 426 and 427, eight months later.

INJURIES OF TIBIA AND FIBULA

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focal infections, tuberculosis or osteochondritis dissecans may also occur to complicate the original injury.

PROGNOSIS. If there are no complications, these patients usually

FRACTURE RECORD					Case No. 80805	Date 6-19-26, 12:30 A.M.								
					Dr. FORRESTER									
Name W. M.	Address 6717 C. MAY STREET													
Age 32	Sex M	M F	M. S. W. D	White-as Colored	Time Occurrence of Accident									
Occupation LABORER					Hospital Entered	WEST SIDE								
Cause of Fracture STRUCK BY FLYING DEBRIS FROM GAS EXPLOSION					First Treatment									
X-Ray No.					Final Reduction	CAST WITH HINGED SPLINT								
EXAMINATION		TREATMENT			RESULT									
Bone TIBIA, FIBULA, RIGHT		Closed Reduction 6-29-25			<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Anatomical</td> <td style="padding: 2px;">Good</td> <td style="padding: 2px;">Moderate</td> <td style="padding: 2px;">Bad</td> </tr> <tr> <td style="padding: 2px;">Functional</td> <td style="padding: 2px;">X</td> <td style="padding: 2px;">X</td> <td style="padding: 2px;"></td> </tr> </table>		Anatomical	Good	Moderate	Bad	Functional	X	X	
Anatomical	Good	Moderate	Bad											
Functional	X	X												
Site AT KNEE JOINT		Method and Position of Fixation												
Type		PLASTER, HINGE AT KNEE												
Simple <input checked="" type="checkbox"/> Compound <input type="checkbox"/>		Anesthetic Used Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>												
Joint Joint <input checked="" type="checkbox"/> Spiral <input type="checkbox"/>		Anatomical Result obtained												
Subperiosteal <input checked="" type="checkbox"/> Intraarticular <input type="checkbox"/>														
Greenstick <input checked="" type="checkbox"/> Comminuted <input type="checkbox"/>		Open Reduction X												
		Method and Position of Fixation												
Description of Deformity including shortening					(a) At discharge from Hospital Date MARCH 3, 1926									
					3/4 INCH SHORTENING, 135 DEGREES FLEXION KNEE X-RAYS FIRM UNION.									
Nature and Extent of Injury to Soft Parts especially nerves and vessels					(b) At discharge from O. P. D. Date MARCH 3, 1926									
					Disability: Absent Partial Complete PARTIAL.									
X-Ray					Mortality Date None									
Before Reduction FRAGMENTS IN GOOD POSITION					More cause of death None									
After Reduction FIRM UNION, GOOD POSITION					Absence from work Duration None									
At Discharge					*Ability to resume job None									
Wassermann Test					*Present Wage earning capacity None									
BLOOD - NEGATIVE.					Compensation obtained: Yes? <input checked="" type="checkbox"/> No? *Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion									

Form 194 (A. & S. Case Record System, Future Company, Chicago)

FIG. 430. Fracture record of case shown in Figures 426-429.

return to work in four to six months, and suffer little or no specific loss. Of course, the period of disability varies with the age of the patient and may be somewhat prolonged in persons of sixty or seventy years of age.

FRACTURE OF THE UPPER AND MIDDLE THIRDS OF THE SHAFT OF THE TIBIA

In the vast majority of cases there is very little displacement in a fracture of the upper and middle thirds of the tibia because of the support that this part of the bone receives from the surrounding muscular structures. Treatment, then, is a very simple matter.

SYMPTOMS. The symptoms include varying degrees of distortion, swelling, ecchymosis, pain, muscle spasm and crepitus. The roentgenograms usually show fracture of both tibia and fibula.

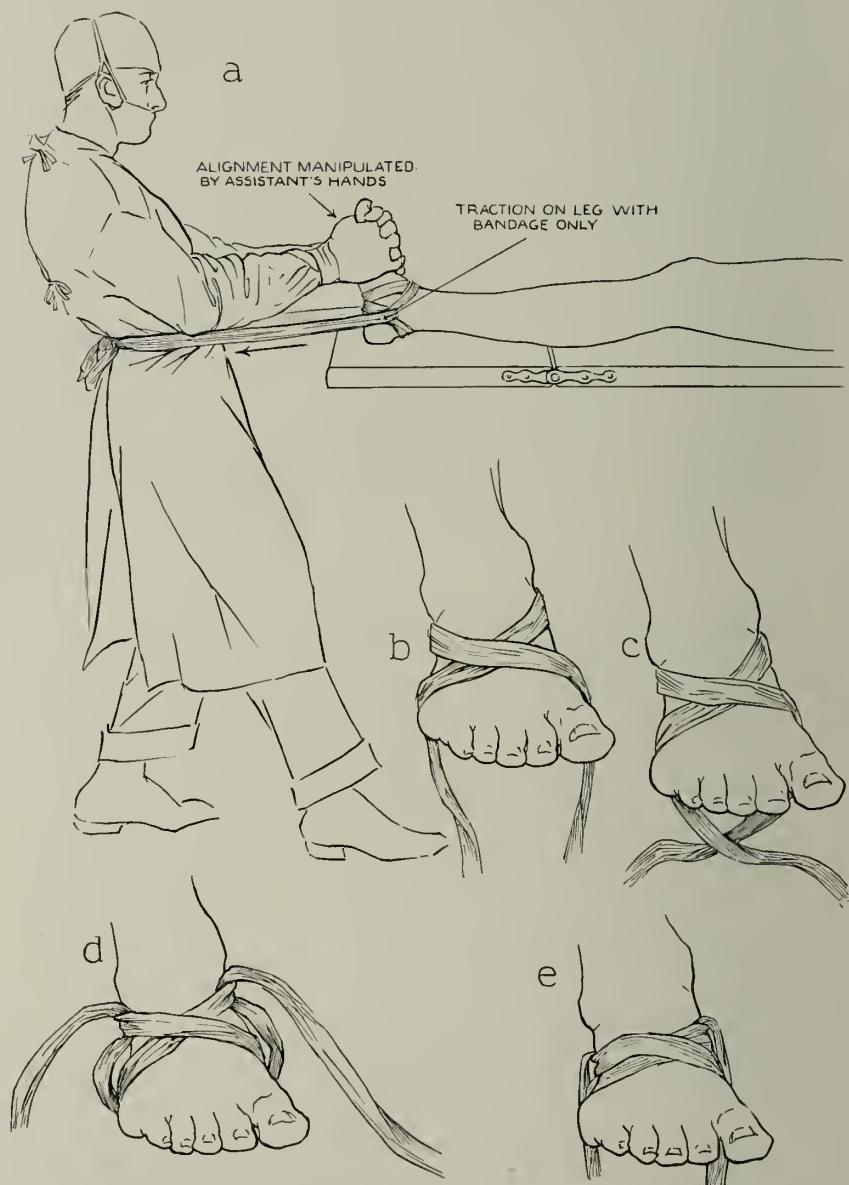


FIG. 431. Method of traction where Hawley table cannot be obtained.

There is marked external rotation of the distal extremity, with angulation. True measurements from the anterior superior spine of the ilium to the internal malleolus will show a shortening.

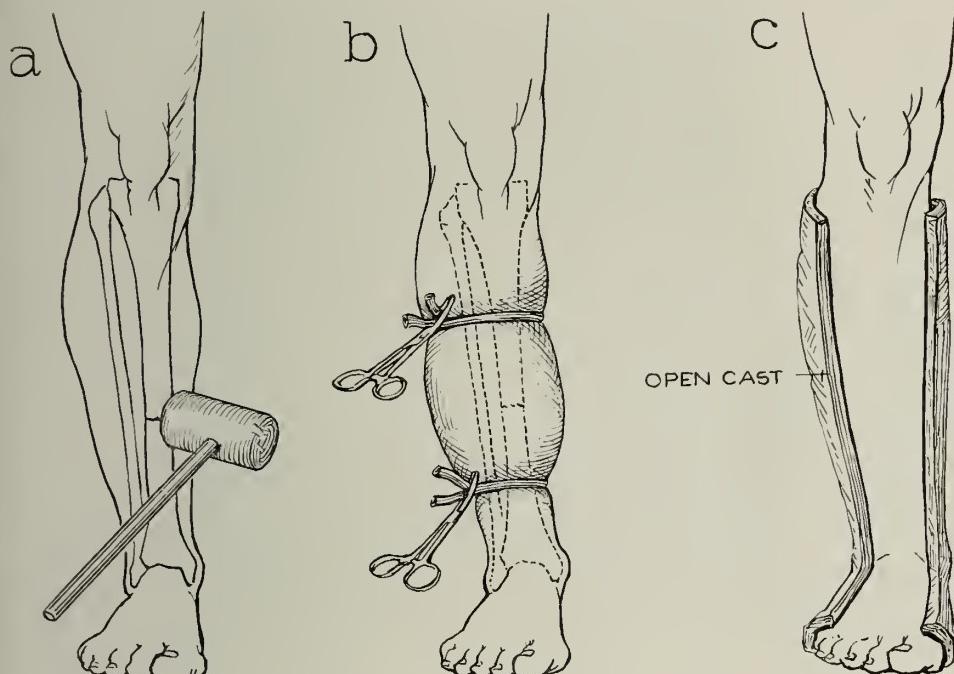


FIG. 432. Method of treating delayed union.

TREATMENT. In the vast majority of cases, extension and manipulation, under anesthesia, suffice to reduce the fragments and to hold them in apposition, because of the support given by the muscles in this vicinity. A posterior molded splint of plaster, with sufficient padding, reinforced by a thin layer of plaster completely surrounding the limb, is sufficient. Great care should be exercised in applying the plaster to see that the heel is well padded; otherwise, pressure necrosis will almost certainly develop. The cast should always extend from the toes to above the knee.

TREATMENT OF DIFFICULT CASES. In an occasional case, where there is an oblique fracture, it may be difficult to hold the fragments in position by this method, and it will be found necessary to devise

some way of resorting to extension (p. 325 in order to preserve the length and alignment of the leg.

It is a well-known fact that even in cases of fracture of this

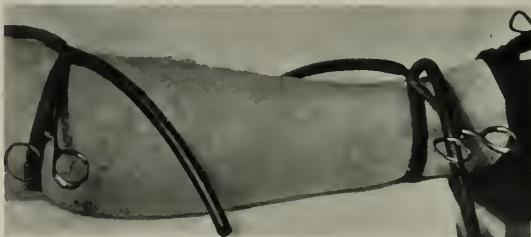


FIG. 433. Author's technique of constriction hyperemia in delayed union.

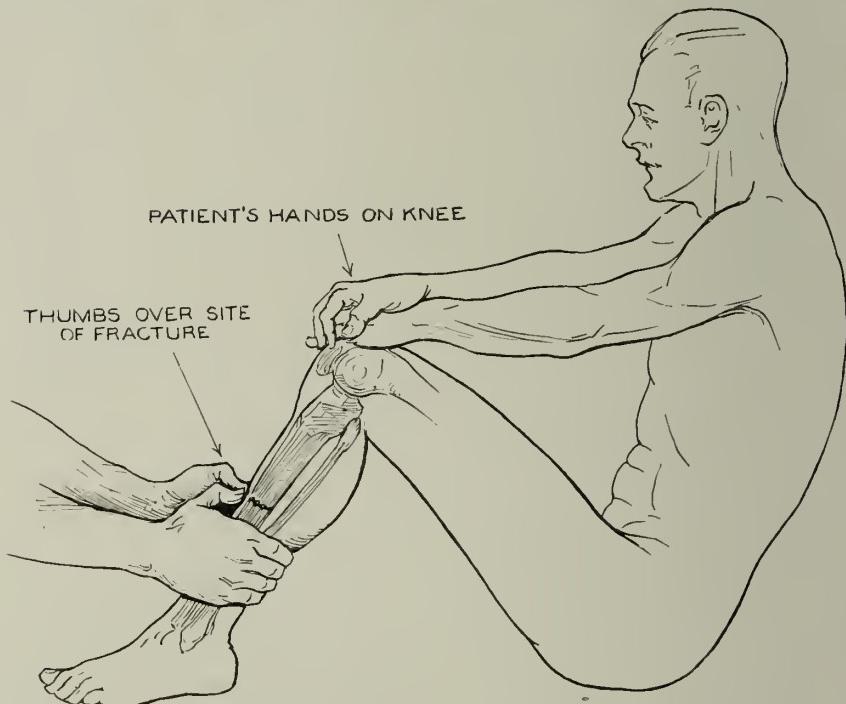


FIG. 434. Method of determining union or non-union of tibia.

nature, a shortening of $\frac{1}{2}$ inch, or even $\frac{3}{4}$ inch is not sufficient to interfere with the function of the limb after union takes place, because this shortening can be satisfactorily overcome either by a compensatory tilting of the pelvis or a building-up of the shoe by

adding to the thickness of the inner and the outer sole. However, since many of the states penalize the employer if an employee suffers any shortening of the limb, irrespective of functional ability,

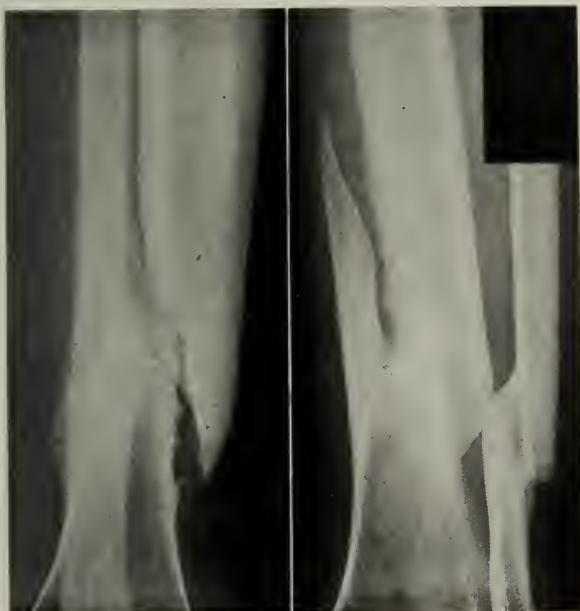


FIG. 435.

FIG. 436.

Figs. 435 and 436. Overriding fracture of the tibia with non-union.

it is advisable to treat the case with the idea of overcoming the shortening completely and not by compensating for it through the use of an orthopedic shoe. Both methods of treatment yield equally good functional results to the patient.

Occasionally, when traumatism is severe, it is advisable to place the limb in a fracture box, because of the post-traumatic blebs which form in the tissues and make it necessary to wait a week or ten days before performing final reduction.

Method of Obtaining Extension to Overcome Shortening. Shortening may be avoided if the limb is extended by one of two practical methods. The first consists in the application of adhesive from the point of fracture downward, as in the application of a Buck's extension; or, second, if adhesive is not available, an adhesive substance can be readily made up by the physician. He may combine acetone

with the silver preparation washed off from an old roentgen-ray film, cutting up the film into small pieces and stirring into the acetone until the mixture assumes the consistency of liquid glue. Three or

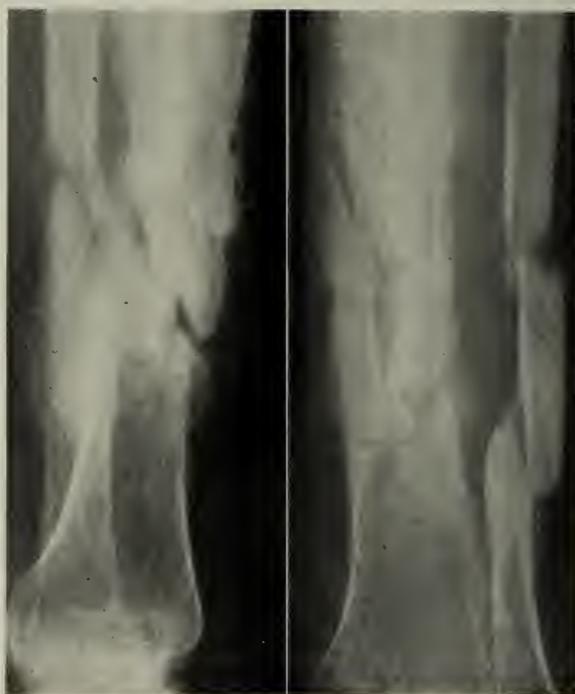


FIG. 437.

FIG. 438.

Figs. 437 and 438. Same case as Figures 435 and 436. Intramedullary beef-bone peg introduced while under Hawley table traction. End-result solid union with no shortening.

four layers of muslin bandage, 3 to 4 inches in width, are then soaked in this solution. Alternate layers of the solution and the muslin bandage are placed on each side of the leg and held in position by a bandage. My own method consists in painting one layer of the solution on the skin over the field desired, and then placing one layer of the muslin strip on the solution and impregnating it by means of a throat stick. The surgeon's hands are thus kept free of contact with the solution. Three to four more layers of the solution and the bandage are next applied in the same manner. This is one of the most practical and effective methods of obtaining extension, as it does not

cause the irritation which follows the use of 20 adhesive. Moleskin adhesive can also be used if it can be obtained.

While the limb is in extension, there are certain points that the

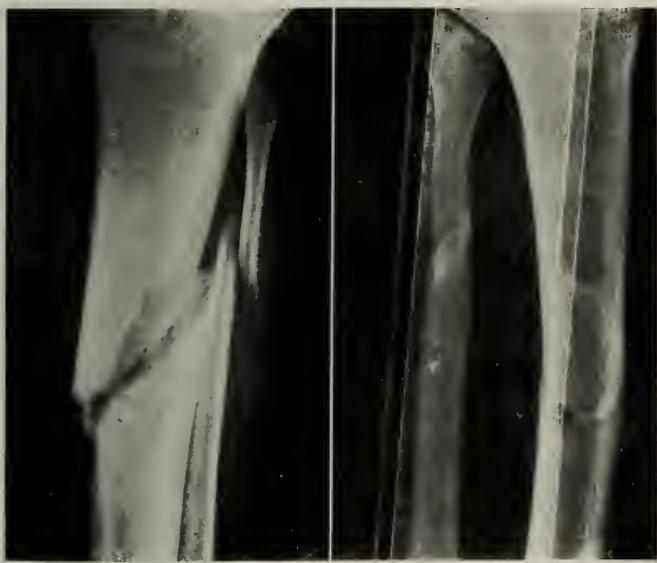


FIG. 439.

FIG. 440.

Figs. 439 and 440. Use of beef-bone peg to maintain fragments in position.

surgeon must observe. First, the knee must be flexed at an angle of at least 10° , and the ankle maintained at right angles to the leg. Flexion of the knee prevents relaxation of the posterior ligament of the knee joint, thereby avoiding a backward snapping of the knee or genu recurvatum. The ankle must be held at right angles to the leg because in patients with rheumatic tendencies, or in under-nourished and thin patients, all of whom may show a tendency to a fibrosis of the joints, this position, should fibrosis develop, is the one which allows the patient the greatest degree of weight-bearing and facility in walking. Should fibrosis develop with the foot in the position of extension, an orthopedic shoe must be worn or a tenotomy of the Achilles tendon must be carried out before the patient can use his foot. The club-foot splint can readily be incorporated in the cast, and will hold the ankle firmly at right angles.

Extension of this kind should not be continued for more than three to four weeks; otherwise, a relaxed capsule of the knee may

result, and the patient will suffer from an unstable knee joint. A weight of 10 to 15 lbs. is sufficient. Extension should be applied only until the roentgen ray shows that a provisional callus has



FIG. 441.

FIG. 442.

FIGS. 441 and 442. Same case as Figures 439 and 440.

formed at the seat of fracture. Then an ordinary plaster cast can be applied for two to three months, depending upon the rapidity of union.

Sometimes, when union is slow, the patient should be permitted to walk with the assistance of crutches, while the cast is still in position. Weight-bearing gradually increased, serves, by irritation, to stimulate bone formation. This is particularly applicable in cases of transverse fractures or oblique fractures, where there is sufficient callus already deposited to prevent shortening. Following removal

of the cast, massage and gradual weight-bearing are necessary. Occasionally removal of the cast is followed by edema of the extremity, in which event an elastic stocking extending from the toes to



FIG. 443.
FIGS. 443 and 444. Same case as Figures 439-442.

above the knee is necessary for a month or so. An Unna's paste dressing may be used instead of the elastic stocking.

COMPLICATIONS. These include fibrosis of the knee or ankle, non-union and possible nerve injury. Where there is an associated fracture of the neck of the fibula, it is advisable to be conservative



FIG. 445.

FIG. 446.

FIGS. 445 and 446. Same case as Figures 439-444.

in the prognosis, because of the possibility of involvement of the anterior tibial nerve, (p. 365) as it passes around the neck of the fibula on its outer side. It may become involved either as a result of direct trauma or subsequent pressure paralysis from callus Lues, focal infections, tuberculosis, sarcoma or possible carcinoma may prove to be a complicating factor.

PROGNOSIS. In uncomplicated cases, the total disability period extends over four to five months, and the partial disability period for another two months.

FRACTURE OF THE LOWER THIRD OF THE TIBIA AND FIBULA

This type of fracture demands entirely different handling from fracture of any other part of the tibia.

FRACTURE RECORD					
Name	F.C.	Address	SUMMIT, ILLINOIS	Case No.	74601
Age	23	Sex	M F	Date	— Hr.
Occupation	STEEL WORKER	M S W D.	White or Colored	Dr.	FORRESTER
Cause of Fracture	LARGE PILE OF STEEL REINFORCING RODS FELL ON L. LEG.			Hospital Entered	ARCHER
				First Treatment	DR. LAIRD
				X-Ray No.	29842
				Final Reduction	DR. FORRESTER
EXAMINATION		TREATMENT		RESULT	
Bone	TIBIA AND FIBULA	Closed Reduction	THOMAS SPLINT WITH TRACTION, THEN CAST.	Good	Moderate
Site	MIDDLE AND LOWER ONE-THIRD	Method and Position of Fixation		Anatomical	Bad
Type:		Anatomical Result obtained		Functional	
Simple	Compound	Yes	No	X	X
X Compound	X Oblique	Anatomical Result obtained		Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve (a) At discharge from Hospital Date 12-31-26	
Tens. Test	Spiral	SLIPPED DUE TO OBLIQUE FRACTURE.		CAST ON LEG	
Subluxated	Injured				
Greenstick	X Comminuted	Open Reduction			
		Method and Position of Fixation		INTERMEDULLARY	
Description of Deformity including shortening		BEEF BONE PEG PUT INTO MEDULLARY CANAL		(b) At discharge from O.P.D. Date 12-16-27	
OVERRIDING OF BOTH TIBIA AND FIBULA		OF BONE.		SOLID UNION, CLINICALLY AND BY X-RAY.	
SHORTENING				1/4 INCH SHORTENING IN LEG 10 DEGREES LOSS ANKLE MOTION.	
		Anatomical Result obtained			
Nature and Extent of Injury to Soft Parts <i>especially nerves and vessels</i>		GOOD		(c) At subsequent date Date	
NERVES AND VESSELS INTACT. SOFT PARTS BADLY TRAUMATISED.		Was non-operative treatment tried first? YES		Disability: Absent-Partial Capacity	
		How long after injury was operation performed? 1 MONTH		20% FUNCTIONAL LOSS OF LEG	
		Was internal fixation material subsequently removed? NO			
X-Ray		Why		Mortality	Date
Before Reduction OVERRIDING TWO INCHES.		When		Main cause of death	
After Reduction STILL SOME OVER RIDING.		Period of Complete Immobilization 6 MONTHS		Absence from work Duration 16 MONTHS	
At Discharge		Period of Protection 8 WEEKS		Ability to resume job GOOD	
Wassermann Test NEGATIVE		Total Period of Protective Treatment 8 MONTHS		*Present Wage earning capacity	
				Compensation obtained: Yes? <input checked="" type="checkbox"/>	

Form 19 A. C. S. Case Record Book

FIG. 447. Fracture record of case shown in Figures 439-446.

SYMPTOMS. The symptoms include distortion, swelling, ecchymosis, crepitus and rotation of the limb below the fracture. Roentgenograms and measurements both aid in diagnosis.

TREATMENT. Transverse Fractures. These occasional cases should be treated by placing the limb in a fracture box for ten days to two weeks, until the swelling has subsided, and the bony outlines can be felt upon palpation. The patient may then be placed on a Hawley or any type of table which allows for counterextension, and, under anesthesia, reduction may be obtained by manipulation. In resorting to this method the muslin or soft gauze roller hitch shown in Figure 431 can be placed about the foot to get extension in low fractures. Then while the cast is hardening it can be cut over the

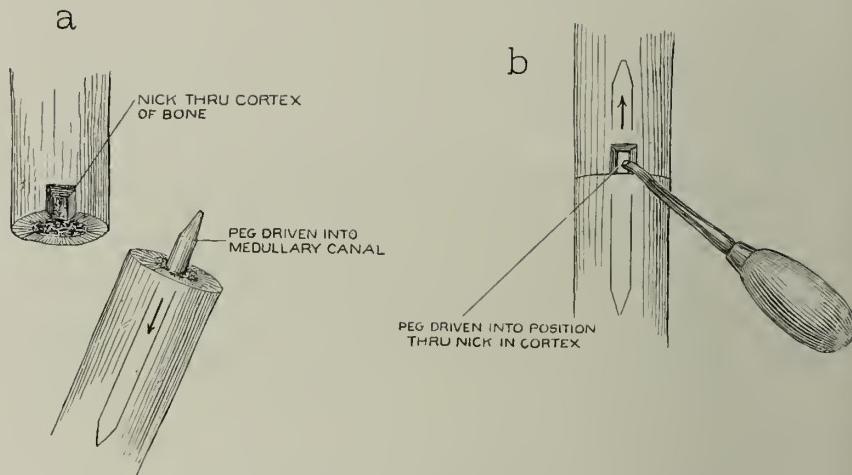


FIG. 448. Simple method of using intramedullary beef-bone peg.

FRACTURE RECORD					
Name	T.B.	Address		Case No.	80466
Age	23	Sex	M.F.	Date	Hr.
Occupation	LABORER			Dr.	
Cause of Fracture	WALL CAVED IN AND BURIED HIM TO WAIST, BREAKING LEFT LEG				
	X-Ray No 32285				
EXAMINATION		TREATMENT		RESULT	
Bone	TIBIA, LEFT	Closed Reduction	6-11-27	Good	Moderate
Site	MIDDLE THIRD	Method and Position of Fixation		Bad	
Type		LEG MANIPULATED AND CAST APPLIED			
Simple	Transverse	Anesthetic Used	GENERAL Yes	No	
Compound	Oblique	Anatomical Result obtained			
Intra-Joint	Synostic	X			
Subarticular	Impacted	Open Reduction		X	
Greenstick	Comminuted	6-15-27 INTRAMEDULLARY			
Description of Deformity including shortening		Method and Position of Fixation		B.B. PEG INSERTED	
		AND PERFECT ALIGNMENT OBTAINED. CAST		APPLIED	
Nature and Extent of Injury to Soft Parts especially nerves and vessels		Anatomical Result obtained		X-RAY SHOWS PEG SATISFACTORY. 7-6-27 SUTURES REMOVED. CAST STILL ON. USES WHEEL CHAIR 7-16-27 X-RAY SHOWS POSITION EXCELLENT	
X-Ray	AFTER REDUCTION. TRANSVERSE FRACTURE MIDDLE THIRD TIBIA; A.P. VIEW	When		X-RAY SHOWS PEG IN POSITION. CALLUS FORM AND EVIDENCE OF B.B. PEG IN MIDDLE INTRAMEDULLARY CANAL. GOOD UNION ALSO OF FIBULA.	
	ALMOST PERFECT. L. VIEW 1/2 INCH DISPLACEMENT. ALSO TRANSVERSE FRACTURE JUNCTION MIDDLE AND UPER THIRD FIBULA; A.P. VIEW PERFECT. L. VIEW GOOD ALIGNMENT	Period of Complete Immobilization		Absence from work. Duration	
		Period of Protection		Ability to resume job	
		Total Period of Protective Treatment		Present Wage earning capacity	
				Compensation obtained: Yes? No?	
Black Ink: Surgeon's Signature Red Ink: Physician's Signature					

Form 19, U.S. Civilian Record System
Customs and Excise Circular, Design

FIG. 449. Fracture record of case treated by intramedullary beef-bone peg.

instep and the gauze or muslin cut and removed. The hitch should *never* be left on after applying the cast, as a necrosis of the foot might follow. The fluoroscope may aid the surgeon in making the reduction.



FIG. 450.

FIG. 451.

FIGS. 450 and 451. Compound comminuted fracture of lower tibia and fibula before application of Steinman pin.

The ragged edges are locked together, where the fracture is transverse, with counterextension still applied, and a plaster cast is put on. It is not necessary to obtain a perfect end-to-end apposition of the fractured surfaces in order to obtain a good functional result. When only half of the surfaces are in contact, providing the weight-bearing line is correct, an excellent functional result is certain without surgical interference. It is imperative to flex the knee at an angle of at least 10° and to maintain it thus. It is preferable, in keeping the ankle at right angles, to invert the foot slightly with the distal foot flat in order to preserve the plantar contour, thus avoiding a possible subsequent flat foot. The cast should be allowed to remain on for two to three months, depending upon the formation of callus.

In some of these cases in which the callus is slow in forming, it is advisable, at the end of five or six weeks, to instruct the patient to come to the surgeon's office on an average of two or three times a

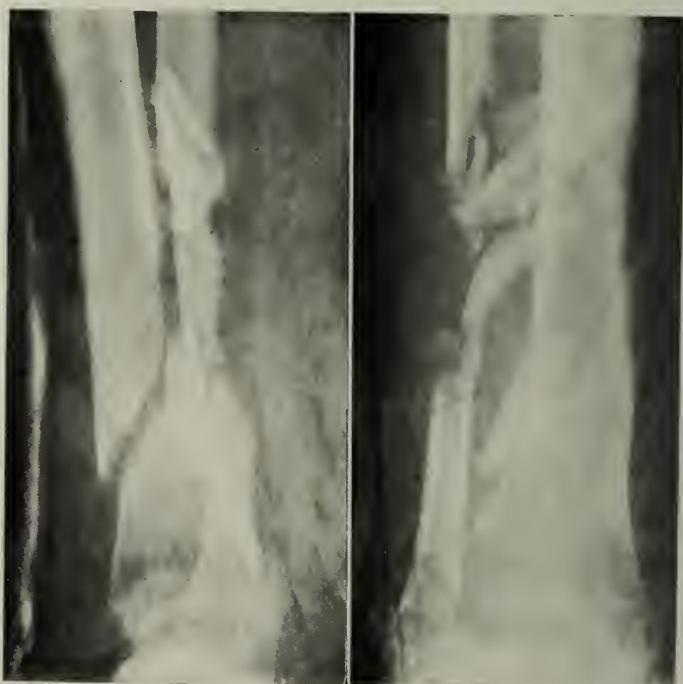


FIG. 452.

FIG. 453.

FIGS. 452 and 453. Same case as Figures 450 and 451. Improvement in alignment following introduction of cast and Steinman pin.

week for treatment. The limb should be removed from the cast and constriction applied just above the ankle and just below the popliteal space, using a strong rubber tubing (Fig. 432). This tight constriction should be maintained with forceps for about twenty to thirty minutes, thereby producing a false hyperemia, and so, by way of the blood stream, forcing nutritive elements into the fracture. This, together with an increasing amount of weight-bearing every day, will very often produce a union when nothing else will help.

Oblique and Comminuted Fractures. Unlike the transverse fractures, these fractures cannot be held in a satisfactory position by the simple application of a cast, because of the muscle pull.

Treatment consists in the introduction of an intramedullary bone peg (Fig. 439) or Steinman pin (Fig. 452) through the heel or os calcis. The application of the Steinman pin depends, as already

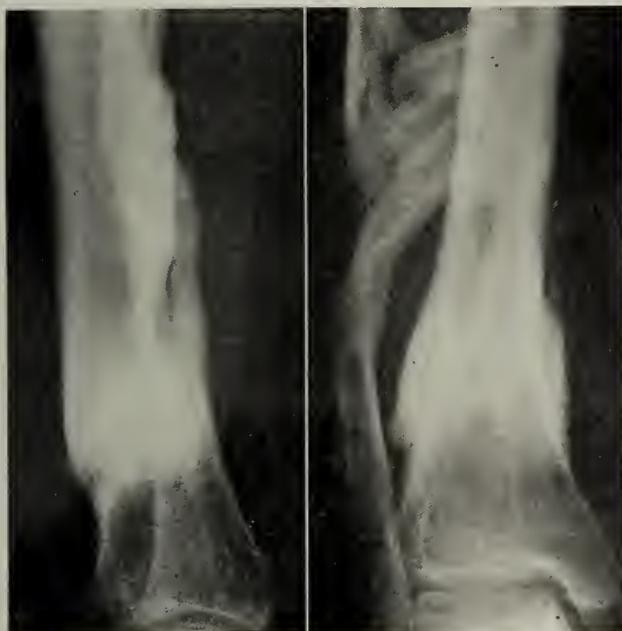


FIG. 454.

FIG. 455.

Figs. 454 and 455. Same case as Figures 450-453. Appearance of limb thirteen months later.

stated, upon the density of the cortex of the bone as determined by the roentgen ray. When it is used gauze is saturated in a solution of 1 to 500 acriflavine and wrapped about the pin on each side. Traction is then applied. With a Steinman pin over 15 lbs. traction should not be used.

While traction is being applied, a posterior molded splint with proper padding (particular attention being paid to the heel), can be put on, and this can be reinforced by a few plaster bandages placed around the entire limb. In this way, we succeed in combining the curative forces of traction, proper alignment and continuous retention of the foot at right angles.

Traction can be continued for four or five weeks without any danger to the patient. By that time sufficient callus will have

FRACTURE RECORD

Case No. 6745

Date 2-23-26 Hr.

Dr.

Name	H. T. S.		Address	
Age	35	Sex	M.	M. 3260
Occupation				
Cause of Fracture	FALL			
EXAMINATION		TREATMENT BY DR.		RESULT
Bone	RIGHT TIBIA AND FIBULA		Closed Reduction PRELIMINARY WITH CAUTERIZATION OF SOFT TISSUE INJURIES	Anatomical Good X Moderate Bad Functional X Description of End Result: Including Deformity, Shortening, Function, Pain, Swelling, Nerve (a) At discharge from Hospital: Date MARCH 30, 1926 OUTWARD BOWING AT SITE OF FRACTURE MODERATE SWELLING
Site	LOWER THIRD		PLASTER PARIS CAST OF ENTIRE LIMB	
Type:	Simple	Transverse	Anesthetic Used GAS Yes No	
	Compound	Obligate	Anatomical Result obtained	
	Intra Joint	Intra	NOT SATISFACTORY	
	Subarticular	Impacted		
	Greenstick	Comminuted	Open Reduction	
Description of Deformity including shortening	STEINMAN PIN THROUGH OS CALCIS WITH APPLICATION OF TRACTION LEG IMMOBILIZED			
BACKWARD DISPLACEMENT LOWER	IN PLASTER CAST			
FRAGMENT OF TIBIA ONE INCH	SENSORY BRANCH OF ANT. CRURAL NERVE			
SHORTENING	SEVERED UNDER LOCAL ANESTHESIA			
Nature and Extent of Injury to Soft Parts especially nerves and vessels	NOT PERFECT BUT SATISFACTORY CONSIDERING EXTENT OF INJURY			
RAGGED WOUNDS POSTERO MEDIAL SURFACE OF LOWER THIRD OF LEG	(b) At discharge from O.P.D.: Date JAN. 5, 1927 DISABILITY: Absent, Partial, Complete			
X-Ray	Was non-operative treatment tried first? YES How long after injury was operation performed? 2 DAYS Was internal fixation material subsequently removed? STEINMAN PIN REMOVED 28 DAYS AND A NEW SECOND CAST APPLIED WITH BETTER ALIGNMENT OF BONE FRAGMENTS When?			
Before Reduction	COMMINUTED, OVERRIDING AND WIDE SEPARATION OF BONE FRAGMENTS FRAKTENS FAIR ALIGNMENTS SICHE BONE LOOSE FRAGMENTS WIDELY			
After Reduction	STEINMAN PIN REMOVED 28 DAYS AND A NEW SECOND CAST APPLIED WITH BETTER ALIGNMENT OF BONE FRAGMENTS When?			
At Discharge	DISPLACED, OVERRIDING REDUCED.			
Wassermann Test	Period of Complete Immobilization 5 MONTHS Period of Protection Total Period of Protective Treatment			
	Mortality Date Main cause of death Absence from work: Duration *Ability to resume job *Present Wage earning capacity Compensation obtained: Yes? No?			
	*Black Ink: Surgeon's Options Red Ink: Patient's Options			

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H.W.S.

- F.H. RECEIVED A COMPOUND COMMINUTED FRACTURE OF LOWER THIRD RIGHT TIBIA AND FIBULA AS RESULT OF A FALL, FEB. 8, 1926. WAS TAKEN TO ILLINOIS CENTRAL HOSPITAL WHERE THE FRACTURE WAS REDUCED AND WOUNDS TREATED, LEG IMMOBILIZED BY DR. HE WAS TAKEN TO THE PEOPLES HOSPITAL SAME DATE. X-RAY COMMINUTED FRACTURE LOWER THIRD LEFT TIBIA EXTENDING INTO ANKLE JOINT. BACKWARD AND OUTWARD DISPLACEMENT LOWER END OF TIBIA. WIDE DISPLACEMENT OF SEVERAL LOOSE BONE FRAGMENTS. COMMINUTED FRACTURE LOWER THIRD OF FIBULA ONE INCH OVERRIDING OF FRAGMENTS WITH CONSEQUENT SHORTENING.
- F.M. FEB. 27, 1926. STEINMAN PIN INTRODUCED THROUGH OS CALCIS AND TRACTION APPLIED. LEG JOINT IN MOLED PLASTER CAST. MARCH 24. STEINMAN PIN REMOVED. LEG PUT IN PLASTER CAST, PRECEDED BY MANIPULATION OF BONE FRAGMENTS TO CORRECT AN UNSATISFACTORY ALIGNMENT.
- MARCH 29. DISCHARGED FROM HOSPITAL; ABUT ON CRUTCHES.
- X-RAY SHOWS SMALL AMOUNT OF CALLUS TISSUE. TWO OPEN WOUNDS, ONE ON EACH SIDE OF HEEL, WITH PRESENCE OF CHRONIC INFECTION AND SOME SLoughING. HEAT AND MASSAGE TREATMENTS AT THE OFFICE BEGAN.

P.L.

- (Details of Treatment, Operation, X-Rays, Diagrams, etc.) MAY 24. ANTERIOR PORTION OF CAST REMOVED.
 AUG. 10, ALL OF CAST REMOVED. SOME DRAINAGE FROM HEEL.
 SEPT. 2. X-RAY CALLUS FORMATION INCREASING, NO PRETENDER MOBILITY.
 DEC. 21. DRATHAZ WOUNDS OF OS CALCIS HAVE HEALED. THERE IS SMALL AMOUNT OF RESTRICTED MOTION OF ANKLE JOINT.
 DISCOMFORT OF INNER SIDE OF LEG (DUE TO IMPINGEMENT OF SENSORY FIBERS LONG SAPHENOUS NERVE). DISCARDED CRUTCHES.
 JAN. 5, 1927. SENSORY BRANCH ANTERIOR CRURAL NERVE EXPOSED UNDER LOCAL ANESTHESIA JUST ABOVE FRACTURE AND SEVERED.
 JAN. '21, NERVE SEVERANCE SATISFACTORY.
 MARCH 12. FINAL EXAMINATION. SLIGHT LIMITATION IN PLANTAR AND DORSAL FLEXION. NO SHORTENING. OUTWARD BOWING DEFORMITY. WALKS WITH SOME LIMPING, AND DOES NOT BEND FOOT.
 CONCLUSION. THE END RESULT IS QUITE SATISFACTORY CONSIDERING THE EXTENT OF THE INJURY. (D.V. BEIGHAM)

Form 19/A.C.S. Case Record System
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FIG. 456. Fracture record (front and reverse) of case shown in Figures 450-455.



FIG. 457.

FIG. 457. Cotton fracture combined with posterior dislocation of astragalus and oblique fracture of fibula.

FIG. 458. Same case as Figure 457, after reduction of Cotton fracture and posterior dislocation.



FIG. 458.



FIG. 459.

FIGS. 459 and 460. Multiple fracture near ankle joint.

FIG. 460.



FIG. 461.

FIG. 462.

FIGS. 461 and 462. Same case as Figures 459 and 460. Reduction with Steinman pin.



FIG. 463. Same case as Figures 459-462, showing end-result in action control of plantar and dorsal flexion.

FRACTURE RECORD									
Name	T.S.	Address	1112 N. DEARBORN STREET			Case No.	74773		
Age	28	Sex	M	S	W-F	White or Colored	Date 10-15-26 H. 9:00 A.M.		
Occupation	PLASTERER						Dr. FORRESTER		
Cause of Fracture	SCAFFOLD BROKE AND HE FELL ABOUT 7 FEET								
EXAMINATION			TREATMENT			RESULT			
Bone	TIBIA AND FIBULA - LEFT			Closed Reduction			Good	Moderate	Bad
Site	LOWER ONE-THIRD			Method and Position of Plaster STEINMAN PIN AND EXTENSION					
Type:				Anesthetic Used Yes No					
Simple	Transverse			Anatomical Result obtained GOOD ALIGNMENT AND POSITION					
Compound	Oblique								
X	Intact Joints	Spur							
	Subluxated	Impacted							
	Grooved	Comminuted			Open Reduction				
					Method and Position of Plaster				
Description of Deformity (including shortening)									
DISPLACEMENT DOWNWARD AND FORWARD OF DISTAL LOWER ARTICULAR SURFACE OF TIBIA									
Anatomical Result obtained									
Nature and Extent of Injury to Soft Parts (especially nerves and vessels)									
EDEMA AND SWELLING									
POSSIBILITY OF COMPOUNDS									
X-Ray									
Before Reduction AS ABOVE									
After Reduction GOOD ALIGNMENT AND POSITION									
At Discharge									
Wassermann Test									
Form 19/A.C.S. Case Record System F. Form Company, Chicago									
(a) At discharge from Hospital Date 12-5-26 NO DEFORMITY. FUNCTIONAL LOSS ABOUT 50% AT ANKLE. NO PAIN, SWELLING OR NERVE INJURY. CAST WITH HINGE ATTACHMENT IN PLACE.									
(b) At discharge from O.P.D. Date TREATED BY DR. PATTON IN SPRINGFIELD. 7-9-27-SLIGHT LIMP, LOSS 10 DEGREES IN FLEXION. EXTENSION OK. SLIGHT THICKENING. 8-5-27-THICKENING ANKLE PRESENT. MOTION SAME. 25% LOSS. At subsequent date Date									
Was non-operative treatment tried first?									
How long after injury was operation performed?									
Was internal fixation material subsequently removed?									
Why									
When									
Period of Complete Immobilization									
Period of Protection									
Total Period of Protective Treatment									
Mortality Date									
Main cause of death									
Absence from work Duration 8½ MONTHS									
Ability to resume job YES									
Present Wage Earning Capacity SAME									
Compensation obtained: Yes? No?									
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion									

Fig. 464. Fracture record of case shown in Figures 459 to 463.



FIG. 465.

FIG. 466.

Figs. 465 and 466. Severely comminuted fracture of ankle involving tibia and fibula with marked deformity. Treated with Steinman pin in os calcis together with cast and ankle splint.



FIG. 467. Same case as Figures 465 and 466. Ankle splints in position.



FIG. 468.

FIG. 469.

FIGS. 468 and 469. Same case as Figures 465 to 467, six months later. For end-results see chart (Fig. 470).

FRACTURE RECORD						Case No. 66679
Name A. T.	Address			Date -	Mr. DR. FORRESTER	
Age 35 Sex M	M. S. W. D.	White or Colored	Time: Occurrence of Accident 4-5-26			
Occupation BOILER MAKER			Hospital Entered BORTH AVENUE			
Cause of Fracture A SCRAPER FELL ON HIS LEFT LEG.			First Treatment 4-5-26			
			X-Ray No. 27470	Final Reduction		
EXAMINATION		TREATMENT		RESULT		
Bone TIBIA AND FIBULA		Closed Reduction		Good	Moderate	
Site LOWER 1/3		Method and Position of Fixation CAST AND MOVABLE		Bad		
Type:		ANKLE SPLINTS.		Anatomical	X	
Simple Transverse		Anesthetic Used Yes No		Functional	X	
Compound X Oblique		Anatomical Result obtained OVERRIDING OF FIBULA		Description of End Result including Disability, Shortening, Function, Pain, Swelling, Nerve		
Joint Joint		AND SOME DISPLACEMENT OF FRAGMENTS.		(a) At discharge from Hospital Date 5-1-26 STILL HAD CAST ON LEG AND WALKED WITH CRUTCHES.		
Subluxated Impacted						
Greenstick Comminuted X		Open Reduction				
		Method and Position of Fixation BY MANIPULATION				
Description of Deformity including shortening		AND TRACTION, CAST AND MOVABLE ANKLE				
COMPLETE LATERAL DISPLACEMENT OF LEG AT		SPLINTS, STEINMAN PIN IN OS CALCIS WITH				
LOWER 1/3.		CAST AND SPLINTS.				
		Anatomical Result obtained GOOD POSITION				
Nature and Extent of Injury to Soft Parts especially nerves and vessels						
LARGE OPEN WOUND ANTERIOR SURFACE OF		Was non-operative treatment tried first? YES				
ANKLE.		How long after injury was operation performed? NONE				
		Was internal fixation material subsequently removed? NO				
X-Ray MUCH DISPLACEMENT		Why		Mortality NO, Date		
Before Reduction POSITION FAIR		Where		Male cause of death		
After Reduction SAU		Period of Complete Immobilization 3 WEEKS		Absence from work: Duration 6 MONTHS		
At Discharge NEGATIVE		Period of Protection 3 1/2 MONTHS		*Ability to resume job YES		
Wassermann Test		Total Period of Protective Treatment		*Present Wage earning capacity		
				Compensation obtained: Yes? No?		
				*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion		

FIG. 470. Fracture record of case shown in Figures 465-469.



FIG. 471.

FIG. 472.

FIG. 471. Extensive fracture of tibia extending into and involving ankle joint. Simple fracture of fibula.

FIG. 472. Same case as Figure 471. Traction with Steinman pin in position.

formed to maintain the alignment. The Steinman pin can then be removed, but the plaster shell should be kept on for two to three months, until complete union takes place. At the end of this time



FIG. 473.

FIG. 474.

Figs. 473 and 474. End-result in same case as Figures 471 and 472, seven months later.

the cast can be removed two or three times a week and passive and active massage instituted at the ankle and knee, to re-establish motion. The question may arise why, in suggesting surgical compounding, I do not refer to Lane plates, bone screws and wires, etc. It is because I find each of these methods unsatisfactory, as they are too subject to complications. My experience indicates that they delay recovery.

COMPLICATIONS. This type of fracture may be complicated by vicious union or union with marked deformity, shortening, joint

INJURIES OF TIBIA AND FIBULA

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fibrosis, occasionally carcinoma or sarcoma, or tuberculosis. Sometimes osteomyelitis or periostitis occurs, due to luetic infection or faulty technique in surgical compounding.

FRACTURE RECORD					
Name P.N.	Address				
Age 26	Sex M.	M. W. B.	White or Colored	Time: Occurrence of Accident	Case No. 65514 Date 1-24-25 Dr.
Occupation LAUNDER	Hospital Entered ST. JOSEPH'S HOSP. JOLIET				
Cause of Fracture PATIENT FELL TOGETHER WITH BOOM OF STEAM SHOVEL	First Treatment 11-24-25				
	Final Reduction 11-25-25				
EXAMINATION		TREATMENT		RESULT	
Bone L. TIBIA AND FIBULA	Closed Reduction	Anatomical	Moderate	Bad	
Site JUNCTION MIDDLE AND LOWER THIRD	Method and Position of Fixation	Functional			
Type: EXTENDING INTO ANKLE JOINT.					
Symple Transverse	Anesthetic Used Yes No	Description of End Result, Indicates Deformity, Swelling, Function, Pain, Sensing, Nerve			
Crossed Oblique	Anesthesia Result obtained	(a) At discharge from Hospital Date 1-27-26			
Int. Joint Sprain		WALKING WITH CRUTCHES, SLIGHT WEIGHT-BEARING INSTITUTED.			
Subperiosteal Inserted					
Greenstick Comminuted	Open Reduction				
Description of Deformity including Abnormalities MARKED SWELLING ECCHYMOSIS	Method and Position of Fixation STEINMAN PIN THROUGH OS CALCIS AND APPLICATION OF TRACTION.	INTRUDUCTION OF FIRM UNION 1/2 INCH SHORTENING. PLANTAR FLEXION LIMIT 10 DEGREES DORSAL EXTENSION LIMIT 30 DEGREES			
Nature and Extent of Injury to Soft Parts (Ankle sprain, etc.)	POSTERIOR NOLOED SPLINT. SPECIAL SPLINT APPLIED 1-2-26 <small>(Ankle and heel charred)</small>	(b) At discharge from O.P.D.: Date 2-16-27			
	GOOD CORRECTION OF DEFORMITY.	FIRM UNION 1/2 INCH SHORTENING. PLANTAR FLEXION LIMIT 10 DEGREES DORSAL EXTENSION LIMIT 30 DEGREES			
	Was non-operative treatment tried? YES	(c) At subsequent date: Date			
	How long after injury was operation performed? 4 DAYS	Disability: Absent, Partial, Complete SPECIFIC LOSS 35%.			
	Was internal fixation material subsequently removed?				
X-Ray MULTIPLE FRACTURE L. TIBIA AND FIBULA JUNCTION MIDDLE AND LOWER THIRD FRACTURE OF TIBIA EXTENDS INTO ANKLE JOINT After Reduction GOOD ALIGNMENT.	Why STEINMAN PIN REMOVED.	Mortality Date			
At Discharge	When	Male case of death			
Wassermann Test	Period of Complete Immobilization 7 WEEKS	Absence from work: Duration			
	Total Period of Protective Treatment	Ability to resume job			
		Present Wage earning capacity			
		Compensation obtained: Yes? No?			
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion Form 19 A.C.S. Case Record System Printed by the Company, Chicago					

FIG. 475. Fracture record of case shown in Figures 471 to 474.

Occasionally the injury is severe enough to produce fracture, but not severe enough to cause any displacement or effusion or any considerable degree of pain. I had one patient who received a simple transverse fracture of the tibia alone, and who walked into the office without any assistance and limping only slightly. The roentgenogram, however, showed a fracture. In every case of injury of the tibia, however slight, roentgenograms should be made in order to avoid the serious results that follow failure to diagnose a possible fracture.

In cases of slow union, laboratory examinations should always be made to see whether any systemic condition can be found to account for it. Occasional surgical cases may progress favorably to a bony union, remain healed for six to eight weeks and then break open. A

few days of rest and quiet may clear up the condition. If, however, a sinus persists, some bone pathology is present and the surgeon must perform operation in order to find and remove the cause.



FIG. 476.

FIG. 477.

Figs. 476 and 477. Multiple comminuted fracture of lower leg with displacement.
Lateral and anteroposterior views.

In cases of slow union there is no harm, after the second month, in having the patients bear a little weight with the cast still in position, in order to stimulate bony union by means of irritation. Constriction hyperemia can also be induced every other day, as mentioned on page 324. In very persistent cases of non-union where not surgically compounded, a gas anesthetic may be administered and irritation produced about the seat of fracture by pounding around the fracture line ten or fifteen times with a rubber-headed mallet



FIG. 478.

FIG. 479.

FIGS. 478 and 479. Same case as Figures 476 and 477. Result immediately following introduction of Steinman pin. Note improvement in alignment of bone.



FIG. 480.

FIG. 481.

FIGS. 480 and 481. Same case as Figures 476-479, six months later.



FIG. 482.



FIG. 483.

FIGS. 482 and 483. Same case as Figures 476-481, showing weight-bearing line.



FIG. 484.

FIG. 485.

Figs. 484 and 485. End-result of surgical compounding using exogenous bone screws, which produced pressure necrosis and subsequent osteomyelitis, wound not breaking down until approximately three weeks later. (See chart, Fig. 486.)

FIG. 486. Fracture record of case shown in Figures 484 and 485.

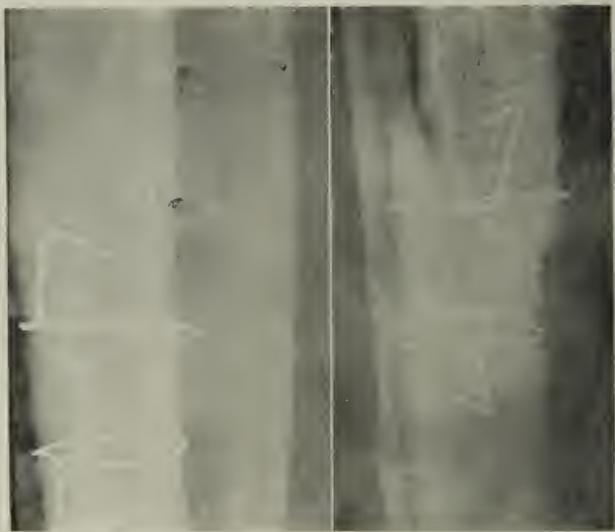


FIG. 487.

FIG. 488.

FIGS. 487 and 488. Poor method of bone fixation. Wires completely around bone interfering ultimately with union.

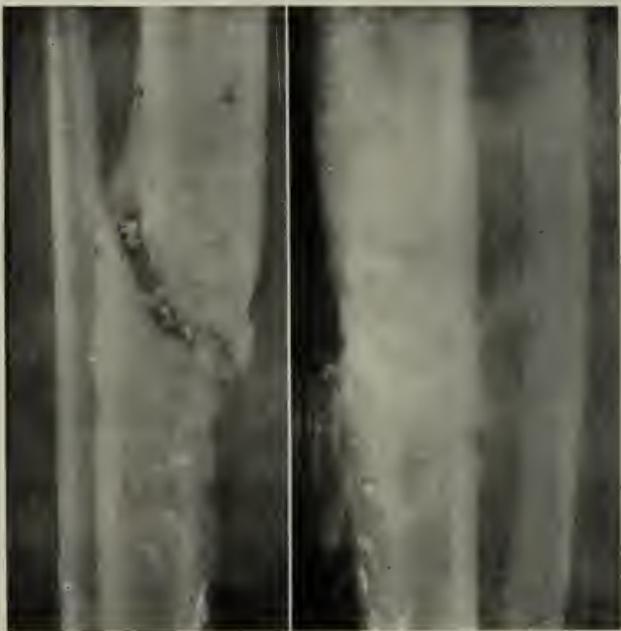


FIG. 489.

FIG. 490.

FIGS. 489 and 490. Same case as Figures 487 and 488. Leg ultimately opened up, wires removed because of non-union, numerous holes drilled in proximal and distal ends of bones to stimulate callus. (See chart, Fig. 491.)

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(see Fig. 432). I have often brought about union in this way. If this method is not successful, operation is the only means of securing bony union. Following union the cast should be reapplied for

FRACTURE RECORD							
Name J. J. T., JR.	Address			Case No. 62971			
Age 27 Sex M	M. S. W. D.	White or Colored			Date 8-31-25	Hr.	
Occupation CARPENTER				Hospital Entered	Dr.		
Cause of Fracture A HEAVY WEIGHT FELL AND STRUCK RIGHT LEG.				First Treatment			
				X-Ray No	Final Reduction		
EXAMINATION		TREATMENT		RESULT			
Bone RIGHT TIBIA	FIBULA	Closed Reduction 9-9-25 OPEN OF. REDUCTION AND FRAC. HELD IN APP. BY 2 SILVER WIRES		Anatomical	Good	Moderate	Bad
Site MIDDLE 3RD	UPPER PORTION	Marked tenderness of fracture AND KANG. TENDON. PLASTER CAST.		Functional			
Type		10-1-26 X-RAY IN OFFICE: PERFECT ALIGN- MENT. TIBIA FRACT. HELD IN PLACE BY WIRES. NO CALLUS. SURG. FOUND HEALED		Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve			
Spiral	Transverse	BY FIRST INTEN. 10-21-25 PL. CAST CHGD.		(a) At discharge from Hospital Date 2-26-26			
Compound	Oblique	TO OFFICE. 3-8-26 X-RAY IN OFFICE. PO-		DISCHARGED FRCA HOSPITAL TO REPORT			
Intra-articular	Spiral	SITION OF FRAC. GOOD. 3-22-26 X-RAY SHOWS					
Subarticular	Irregular	MARKED IMPROV. IN BONY UNION. 4-30-26					
Grossly	Comminuted	X-RAY: GOOD CALLUS ABOUT FIB. NONE ABOUT		X-RAY SHOWS CALLUS BUT NOT ENOUGH TO			
Description of Deformity including shortening	OBL. FRACT.	TIBIA. 2-17-26 GENL. ANESTHESIA. WIRES		REM CAST. POS. AND ALIGN. GOOD. 5-19-26			
Mid. 3RD R. TIBIA. OVERRIDING TRANSV.		REMOVED AND BONE STIM. BY IRRIT. ENDS OF		CAST RE. BUT NO WT. TO BE PUT ON LEG.			
FRACT. UPPER PORTION OF FIBULA, ALSO		KANG. TENDON. BONES, FOUND CLOSED AND		OPEN GRAN. ED. ON OUTER TIBIA. 6-4-26			
OBL. FRACT. WITH NO DISPL. LOWER PORTION		CAST AFFILI.		DEF. LYMPHADENITIS, TAVERN TO HOSE. DEVELO-			
OF FIBULA.				G. AND MAR. ABDOMINATLY OF GROIN TEMP.			
Nature and Extent of Injury to Soft Parts	especially nerves and vessels			100 AND LYMPHAD. OF ENTIRE LEG. UNION			
		Was non-operative treatment tried first?		AT SEAT OF FRACT. APPEARS SOLID. 6-24-26			
		How long after injury was operation performed?		HOME FRC. HOS. S. SFIC 15 BCUB. DISCH.			
		Was external fixation material subsequently removed?		FRAC. SINUS TRACT PLASTER OF 5-13-26 COMPL.			
X-Ray		When		BOTH UNION. HAD NO SHORTENING. WALKS WITH			
Before Reduction				CANE. NO LIMP OR FAVORITING OF MEMBER.			
After Reduction				10-1-26 X-RAY WITH SLIGHT LIMP (MOSTLY			
At Discharge				HABIT). NO SHORT. NO LIMITATION IN KNEE OR			
Wassermann Test	2-20-26 NEGATIVE	Period of Complete Immobilization		PRESENT. WALKS STRONG, EASILY.			
	7-21-26 NEGATIVE	Period of Protection		ANKLE. ABLE TO WORK. NO SEC. LOSS.			
		Total Period of Protective Treatment		COMMUNICATED. YES? NO?			
Black Ink: Surgeon's Signature Red Ink: Patient's Signature							

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FIG. 491. Fracture record of case shown in Figures 487-490.

six to possibly eight weeks. In some instances constriction hyperemia following removal of the cast is advisable (Fig. 433).

PROGNOSIS. The disability period in these cases extends over four to six months. There may be some specific loss of function due to shortening or to fibrosis of the joints; the latter, however, can be materially lessened by early massage. In determining the amount of shortening, measurements should be taken from the inner head of the tibia to the inner malleolus, rather than from the anterior superior spine of the ilium to the inner malleolus, because the latter measurement sometimes shows variations which may be entirely normal, or due to some other injury than the fracture of the tibia.

FRACTURE OF THE LOWER END OF THE TIBIA EXTENDING
INTO THE ANKLE JOINT

SYMPTOMS. This common injury, which as a rule leaves the patient



FIG. 492.

FIG. 493.

Figs. 492 and 493. Case treated without surgical interference. Excellent functional result but shortening that called for compensation under Compensation Law.

with considerable functional disability, is characterized by distortion, pain, sometimes ecchymosis, definite limitation of motion, inability to bear weight, crepitus and marked effusion about the ankle joint. Both anteroposterior and lateral films should be made in order to determine accurately the extent of the fracture.

TREATMENT. I follow one method usually in the treatment of this injury. For the first week or ten days it is inadvisable to attempt much manipulation, except for the relief of pain. As soon as possible after the injury the patient may be anesthetized with gas, whatever manipulation seems wise to the surgeon may be performed, and a posterior molded splint put on with proper padding over the heel and back of the leg and maintained with a plain bandage. Slight

traction may be applied, but only with great care, in the early stages, because of the possibility of pressure necrosis.

At the end of a week or ten days, when the swelling has subsided,



FIG. 494. Spiral fracture of tibia calling for open operation to avoid shortening. Exogenous bone screws used.

the patient is placed under a general anesthetic and the plaster cast removed, but kept in readiness for reapplication. The limb is prepared as for a general surgical operation and, if the cortex of the bone is durable and strong, as shown by the roentgen ray, a Steinman pin is inserted in the os calcis. The surgeon must be very careful to use this pin only in cases in which the bone cortex is strong; otherwise it will cause pressure necrosis and a sinus. After the pin has been applied and traction instituted by means of a weight of 10 to 15 lbs., a special splint that I have devised for these cases is then incorporated in the plaster about the foot, and the ankle left exposed (Fig. 532). The posterior molded plaster cast is then reapplied. The



FIG. 495.

FIG. 496.

Figs. 495 and 496. End-result in same case. Bone necrosis, osteomyelitis, practically two years' disability, showing inadvisability of using any method of bone fixation which calls for pressure of cortical bone.

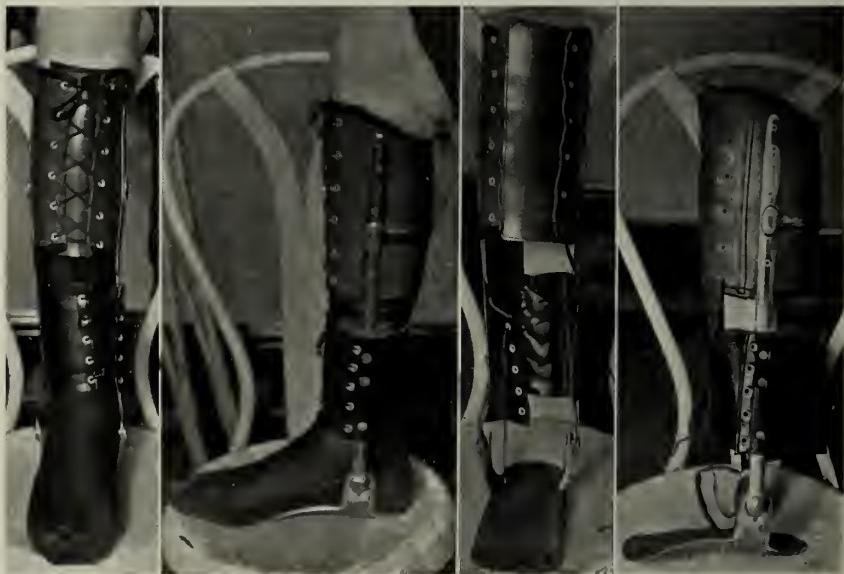


FIG. 497.

FIG. 498.

FIG. 499.

FIG. 500.

Figs. 497-500. Maintaining alignment of limb while cleaning up infection. Splint used to prevent shortening of tibia and also to prevent fibula being pushed down into ankle joint.



FIG. 501.



FIG. 502.

FIGS. 501 and 502. Spiral fracture in which closed reduction relieves slight amount of overriding but which from physical standpoint leaves no functional impairment. Industrial Commission holds that in such a case patient is entitled to definite remuneration, hence necessity of getting as complete reduction as possible.

foot should be slightly inverted and the plantar arch carefully maintained.

For the first week after the pin is inserted, traction on the ankle



FIG. 503. Unusual multiple fracture of both bones of ankle with external dislocation of foot. Not compounded.

joint only is permitted. After this, very slow motion in the ankle is instituted every third day the movement extending not over 5° to 10° , and position maintained by locking the splint.

This method of treatment serves (1) to draw the astragalus away from the ankle joint by means of the insertion of the Steinman pin, and (2) to institute early motion, which molds the soft callus of the lower end of the tibia to the contour of the ankle joint. Very little irritation is produced in the os calcis by the Steinman pin.

The Steinman pin should be removed at the end of four to five weeks, but the ankle splint may be left on for six or eight weeks. At the end of this time no further support is necessary; passive and

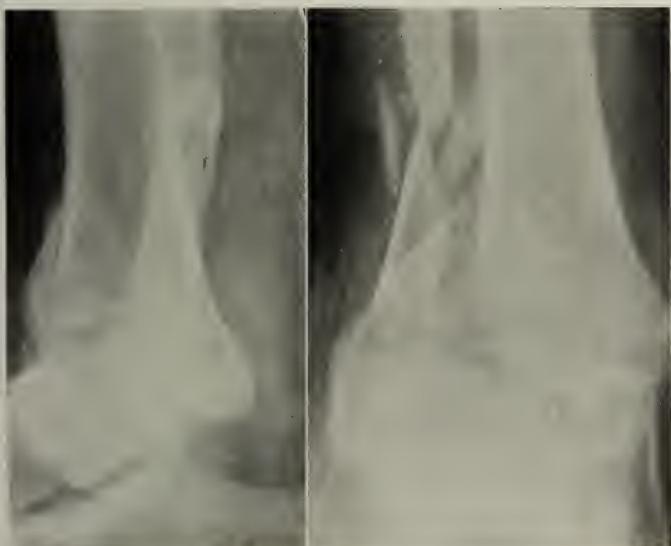


FIG. 504.

FIG. 505.

Figs. 504 and 505. Same case as Figure 503, after first reduction.

active motion may be resorted to, and weight-bearing started at the end of the third to the fourth month, depending upon the rapidity of healing.

Occasionally, in cases with almost no displacement of fragments, the ankle splint without the Steinman pin provides all the support necessary to healing and motion. In these cases the patient may get up on crutches at the end of the second week, the cast acting by gravity as a means of extension.

Any shortening (and in these cases there is always some degree of permanent deformity despite all treatment) should be compensated for by the use of a shoe with a Crook's heel and a Dutchman (Fig. 545). Sometimes only a Crook's heel is necessary.

If a fracture of the inner malleolus is associated with a fracture of the lower end of the tibia, considerable attention must be paid to inverting the foot, and this inversion should be maintained precisely as in the treatment of Pott's fracture (p. 358).

In such a case motion should not be started until the end of the third week, since the inner malleolus is subject to absorption with non-union.



FIG. 506. Same case as Figures 503-505. Condition at end of four months. Steinman pin would have improved end-result in this case. (See chart, Fig. 507.)

PROGNOSIS. The disability period extends over at least six months. The patient is left with some degree of functional disability, in spite of any form of treatment, especially in those cases showing extensive displacement or comminution.

POTT'S FRACTURE

SYMPTOMS. The symptoms of this condition include marked lateral displacement of the ankle joint toward the outer side, effusion, definite widening of the malleolar arch, intense pain, muscle spasm, limitation of motion, bone crepitation, ecchymosis and preternatural mobility of the ankle. The roentgenograms supplement these symptoms admirably in establishing the diagnosis.

INJURIES OF TIBIA AND FIBULA

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As a rule, the roentgenograms show a breaking-off of the internal malleolus of the tibia, with fracture of the fibula 2 or 3 inches above the ankle joints.

FRACTURE RECORD					
Name	U.H.	Address	1928 BERYN AVENUE		
Age 48	Sex M	M S W D	White or Colored		
Occupation			Time of Occurrence of Accident 12-2-25		
Cause of Fracture FELL ABOUT FOUR FEET			Hospital Entered WEST SIDE		
			First Treatment 12-2-25		
			Final Reduction 12-5-25		
X-Ray No.			Case No. 68726 Date 12-2-25 Hr. Dr. FORRESTER		
EXAMINATION			TREATMENT		
Bone LEFT TIBIA AND FIBULA			Closed Reduction		
Site LOWER 1/5 FIBULA & INTERNAL MALLEOLUS			Method and Position of Fixation PLASTER CAST WITH SPECIAL ANKLE SPLINT.		
Type COMMUNICATED			Anesthetic Used Yes No		
Simple	Transverse		Anatomical Result obtained GOOD		
Compound	Obligate		(a) At discharge from Hospital Date 12-12-25		
Joint	Spiral		IN CAST		
Subperiosteal	Impacted				
Greene's	X Comminuted		Open Reduction		
Description of Deformity Involving shortening LATERAL			Method and Position of Fixation		
DISPLACEMENT OF FOOT WITH WIDE SEPARATION OF FRAGMENTS OF FIBULA.			(b) At discharge from O.P.D. Date 3-29-26		
			SLIGHT DEFORMITY PRESENT. SOME LIMITATION OF MOTION AT ANKLE JOINT.		
Nature and Extent of Injury to Soft Parts especially nerves and vessels			Anatomical Result obtained		
CONTUSION OF SOFT PARTS			(c) At subsequent date Date		
			Disability: Abnormal, Partial, Complete		
			TEMPORARY TOTAL 4 MONTHS		
X-Ray			Mortality Date		
Before Reduction WIDE SEPARATION OF FRAGMENTS			Main cause of death		
After Reduction GOOD POSITION, ALIGNMENT			Absence from work Duration 4 MONTHS		
At Discharge CALLUS FORMATION WITH SYNOSTOSIS			Ability to resume job		
Wassermann Test NEGATIVE			Present Wage earning capacity		
			Compensation obtained: Yes No		
			*Black Ink: Surgeon's Signature Red Ink: Patient's Signature		

Form 19 (A.C. & C. Case Record System)

Futura Cemetery, Chicago

FIG. 507. Fracture record of case shown in Figures 503-506.

TREATMENT. In cases with little or no swelling, these fractures may be reduced immediately; but, in most cases, there is so much effusion and so much thickening of the tissues that it is advisable to wait a week or ten days before attempting reduction. Some manipulation may be necessary immediately after injury in order to relieve the pain and prevent interference in circulation. If this is done, partial reduction may be effected, the limb placed in a fracture box and ice bags or hot dressings applied.

In reducing this fracture it is advisable to administer a general anesthetic. A local can be used by one experienced in the technique of Böhler of Vienna. The surgeon should always increase the deformity by abduction or eversion of the foot. He should then bring the foot into a position of forced inversion, even placing it slightly

beyond a right angle in the position of dorsal flexion with the toes flat, not inverted, thus bringing down the shaft of the fibula, and at the same time forcing the inner malleolus of the tibia against its



FIG. 508.

FIG. 509.

FIGS. 508 and 509. Compound Pott's with Cotton fracture, atypical.

opposing surfaces. The foot should be dressed in this position by means of a plaster shell extending from the toes up to the popliteal space. If this fracture has been properly reduced, the foot can be held at right angles without force, by placing a finger against the ball of the foot. The arch of the foot should be kept as high as possible, and this is done by the inversion of the foot.*

The cast should be left on for at least six weeks, and longer, if necessary, depending upon the age of the patient and the rate of callus formation as demonstrated by the roentgen rays. At the end

* Professor Lorenz Böhler of Vienna teaches just the opposite procedure, viz., to maintain the astragalus in a direct line with the long axis and slightly invert the os calcis, keeping the ball of the foot perfectly flat (instead of inverting the foot, which tends to increase rather than decrease the arch). On a skeleton his method appears to be correct.

of this time the limb should be removed from the cast every other day, while passive and active motion is applied. Two to two and one-half months after reduction the cast should be permanently



FIG. 510.

FIG. 511.

Figs. 510 and 511. Appearance of foot in same case after treatment was completed. removed and gradual weight-bearing begun, in conjunction with massage and diathermy.

PROGNOSIS. In these cases the disability period usually lasts longer than one expects. It averages at least six months, if not longer. It is followed by a definite loss of function, because, no matter how careful the treatment, such a complication as widening of the malleolar arch or some pronation of the foot may cause faulty weight-bearing. These patients must wear a shoe with a Crook's heel or with a Crook's heel and a Dutchman applied to the inner side of the sole of the shoe. In spite of his discomfort, the patient must be constantly encouraged to continue the treatment and weight-bearing, even though the period of treatment be a long one; only in this way can the greatest correction of faulty weight-bearing be attained.

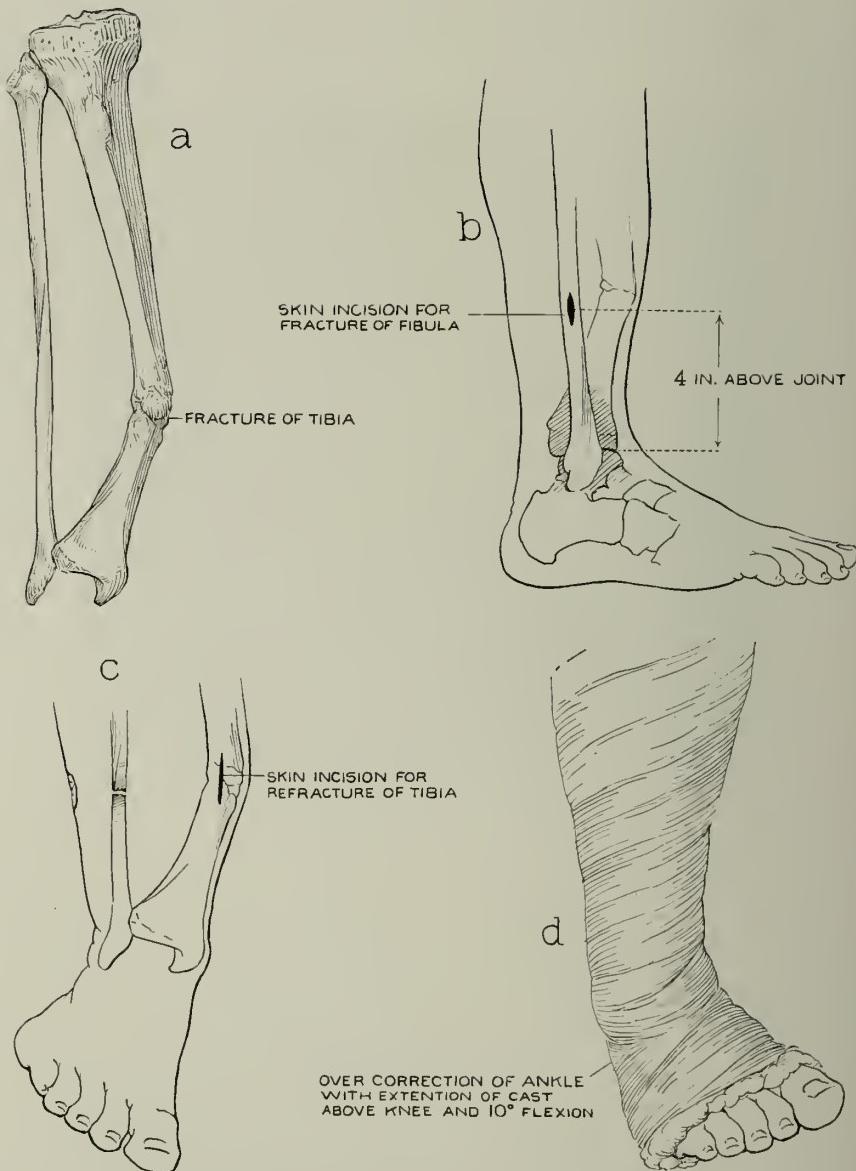


FIG. 512. Surgical correction of angular union.

Focal infections are often responsible for a prolonged disability period. The age and weight of the patient also materially affect the outcome, to say nothing of improper methods of reduction. In elderly people complications due to age are often responsible for a disability period of nine months to a year, and cause some permanent loss of function. The patient's vocation may also be responsible for a long disability period, since a roofer, a steel worker or a man engaged in some other kind of construction work that demands considerable movement and weight-bearing cannot return to work as soon as can one engaged in less active work.

Occasionally where these people do not receive a proper reduction and the end-result is a wide malleolar arch with marked pronation of the foot and faulty painful weight-bearing, a subsequent osteotomy of the tibia, taking a V out of the inner side, can be performed. I do not advise this being done, however, except by an experienced bone surgeon.

ANGULAR OR VICIOUS UNION OF FRACTURES OF TIBIA AND FIBULA

These cases, which are not at all uncommon, have undergone faulty treatment or else have had no treatment at all because of failure to recognize the fracture. Faulty weight-bearing is evident, and causes marked pain in either the knee or the ankle, or sometimes in both. The patients are usually entirely unable to work.

TREATMENT. In order to obtain a functionally satisfactory limb, it is necessary to refracture the limb and place it in proper alignment for weight-bearing. Such a procedure means that two operations must be performed, but both can be done at one sitting.

An incision is made over the fibula, preferably at the junction of the middle and lower thirds of the bone. This incision extends down to the shaft of the fibula and avoids the sheaths of the peroneus longus and brevis tendons. Then, with either a bone-cutting forceps or a chisel, the fibula is broken subperiosteally. This wound is closed completely, as if the operation were finished.

A small incision $1\frac{1}{2}$ inches in length is next made on the front of the shaft of the tibia and extending down to the periosteum. The periosteum can then be peeled away from the bone. With a hammer and chisel the fracture of the tibia can be broken up and reset or refractured above the old break, and a plaster cast applied. This is

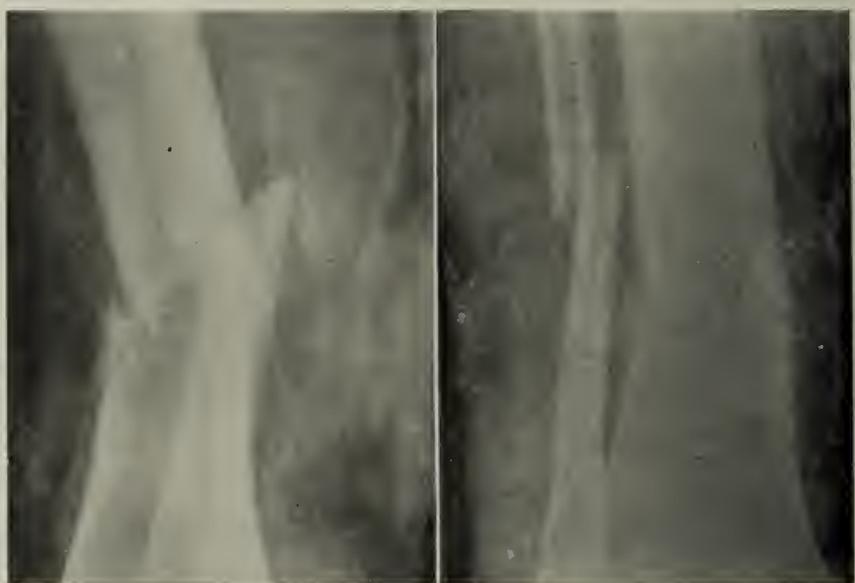


FIG. 513.

FIG. 514.

FIGS. 513 and 514. Angulation before wedging, showing anteroposterior and lateral views. Note forward angulation as well as lateral.

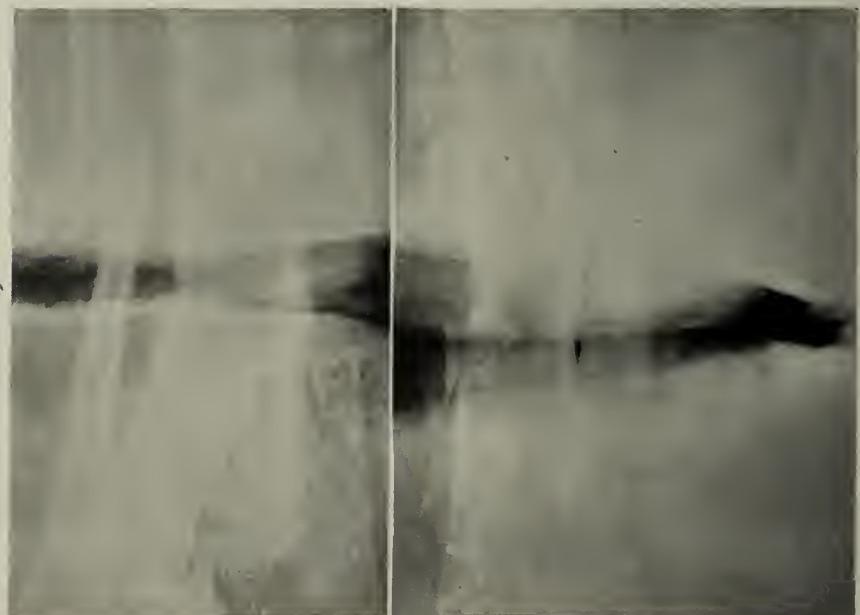


FIG. 515.

FIG. 516.

FIGS. 515 and 516. Wedging process in same case as Figures 513 and 514. Note correction of forward angulation.

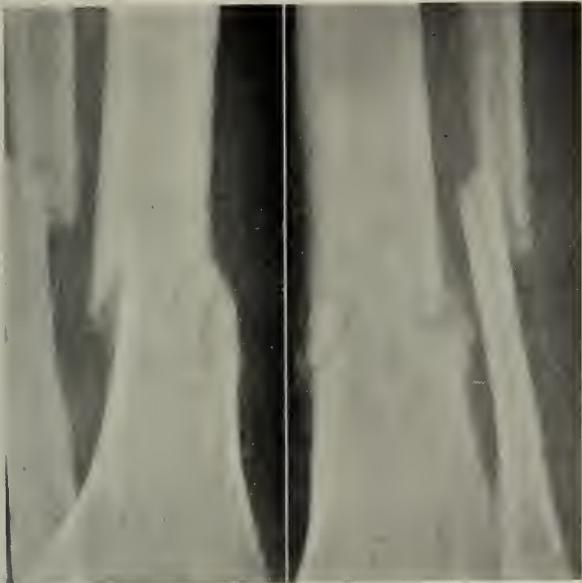


FIG. 517.

FIG. 518.

Figs. 517 and 518. Same case as Figures 513-516, showing end-result following wedging.

FRACTURE RECORD

Name <u>L.B.</u>	Address _____	Case No. <u>75856</u>							
Age <u>21</u>	Sex <u>M</u>	Date <u>11-22-26</u>							
Occupation <u>BELL BOY</u>	White or Colored	Hospital Entered _____							
Cause of Fracture <u>FELL INTO OPEN ELEVATOR SHAFT</u>		First Treatment _____							
		X-Ray No. _____							
EXAMINATION		TREATMENT	RESULT						
<u>Bone BOTH BONES LEFT LEG</u>		<u>Closed Reduction</u>	<table border="1" style="width: 100px; margin-left: auto; margin-right: auto;"> <tr> <td>Anatomical</td> <td>Good</td> </tr> <tr> <td>Functional</td> <td>Moderate</td> </tr> <tr> <td></td> <td>Bad</td> </tr> </table>	Anatomical	Good	Functional	Moderate		Bad
Anatomical	Good								
Functional	Moderate								
	Bad								
<u>Site JUST ABOVE ANKLE</u>		<u>Method and Position of Fixation</u>							
<u>Type DEEP COMPOUND CONTINUED FRACTURE</u>		<u>Anesthetic Used</u> <u>GENERAL</u> <u>Op. No.</u> <u>-Ner</u>							
Simple	Transverse	Anatomical Result obtained	Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve						
Compound	Oblique		(a) At discharge from Hospital Date <u>1-5-27</u>						
Intra-Joint	Spiral								
Subperiosteal	Impacted								
Greenstick	Comminuted	<u>Open Reduction OPEN WOUNDS REPAIRED, BONE</u> <u>MAINTAINING POSITION FRAG. REDUCED,</u> <u>PLASTER CAST APPLIED.</u>							
Description of Deformity including shortening									
<u>EXTENSIVE LACERATED WOUNDS ABOUT LEFT</u> <u>TARTRAL REGION. DEEP PUNCT. WOUND</u> <u>LEFT BUTTOCKS.</u>		<u>12-10-26 FAIR CRUTCHES SUPPLIED.</u> <u>SURGICAL AS WELL AS TRAUMATIC WOUND.</u>							
		<u>12-14-26 IN OUR OFFICE</u>							
		<u>SLIGHT LACK OF ALIGNMENT OF BONE ADJUSTED</u>							
Nature and Extent of Injury to Soft Parts especially nerves and vessels		X-RAY THEN SHOWED POSITION AND <u>WAS INTERNAL FIXATION MATERIAL SUBSEQUENTLY REMOVED?</u>	(c) At subsequent date, Date						
		<u>REPORT EARLY IN 1927.</u>	Disability: <u>Absent</u> , Partial, Complete						
		<u>Was internal fixation material subsequently removed?</u>	X-RAY SHOWS NO CHANGE IN POSITION OF BONES FROM PREVIOUS PICTURE. FIXED						
X-Ray		Why _____ When _____	MONTHLY DRESSING STILL <u>ON</u> IN PLACE. <u>1/15/27 CAST REMOVED. X-RAY:</u>						
Before Reduction			<u>Absence from work - <u>None</u> SHOWS POSITION OF</u>						
After Reduction		Period of Complete Immobilization	<u>*ADMIT TO HOSPITAL FOR BONES GOOD SITE EXCELLENT</u>						
At Discharge		Period of Protection	<u>*PRIMER-WHEAT CALLUS FORMATION</u> <u>ABOUT SITE OF FRACTURE. A LIGHT CAST</u> <u>COMPOSITION-<u>absent</u>-Yes? No?</u> <u>THE POSTERIOR MOULDED SPLINT WAS</u> <u>APPLIED. SOME WEIGHT BEARING TO BE ALLOWED.</u>						
Wassermann Test		Total Period of Protective Treatment							

Form 19 (A.C. 3) Case Record, Urban
Particulars Only

Fig. 519. Fracture record of case shown in Figures 513-518.

left on for two and one-half or even three months; sufficient time to obtain bony union.

It is advisable to keep in mind that in doing this operation the



FIG. 520.

FIG. 521.

FIGS. 520 and 521. Simple fracture of tibia and fibula. On admission marked angulation; physical condition prevented operation; wedging resorted to. End-result after eight months.

deformity must be overcorrected. The reason for this is that where deformity is manifested by a bowing of the limb, there is a natural contraction of the muscular structures on the concave side. After a period of weeks or months of weight-bearing, these muscles become very tense. If, then, the defect is corrected only to a point of alignment, before the cast has been completely applied the natural contraction of these tense muscles will again have caused bowing, although it may not be so pronounced as that evident before operation. Overcorrection, then, is the only way to counteract this natural overcontraction of the muscles.

Special attention should be paid to placing the foot in the correct position, because when deformity has existed for a considerable period the foot is apt to be pronated, and there probably is a fibrosis



FIG. 522.



FIG. 523.

Figs. 522 and 523. Roentgenogram in same case showing effect of wedging.

of the small bones, which is fairly evident even under anesthesia. Forceful manipulation of the foot must be done in order to break up the adhesions. When this has been accomplished, the foot should be inverted and placed at right angles to the leg.

COMPLICATIONS. A return of angulation through failure to over-correct the deformity or through failure to correct faulty weight-bearing is all too common a complication.

Improper osteotomy of the fibula may also cause considerable postoperative trouble. I have in mind a case in which the surgeon, instead of refracturing the fibula at its most subcutaneous point, which lies approximately at the junction of the middle and lower thirds, made an incision at the head of the fibula, forgetting altogether that the anterior tibial nerve passes around the outer side of the fibula. All the branches of the tibial nerve were severed and

the patient was left with a paralyzed anterior group of muscles, a condition which caused foot-drop.

Recurrence of the original deformity may be caused by too early



FIG. 524.



FIG. 525.

Figs. 524 and 525. Same case as Figures 520-523, showing method of wedging.

removal of the cast. The time of removal depends upon the rapidity of callus formation as determined by manipulation and roentgen-ray findings.

PROGNOSIS. In uncomplicated cases, total disability lasts for three to four months, and partial disability for another two months.

WEDGING OF CASTS TO CORRECT ANGULATION WHILE UNION IS INCOMPLETE

If a fractured tibia, or for that matter any long bone, shows inward or outward, backward or forward bowing while the callus is still malleable, a cast may be applied from the toes to above the knee, with the knee in a position of 10° flexion and the foot inverted and at right angles to the leg. After it has hardened, the surgeon cuts the cast entirely around the point of fracture and on the inner or outer side of the cast (depending on the angulation) cuts out a transverse semilunar portion an inch in width. Then on the inner or

INJURIES OF TIBIA AND FIBULA

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outer side of the cast, by forcibly bending the leg and thus widening the cut, he slips in one or two pieces of wood, such as throat sticks. He retains these in position by means of adhesive. He repeats this

FRACTURE RECORD												
Name N.P.D.	Address 2841 N. ROCKWELL											
Age 49	Sex M	Married Y	White or Colored White									
Occupation BRICKLAYER		Time of Occurrence of Accident 6-17-26 4:00 P.M.										
Cause of Fracture FELL FROM SCAFFOLD CATCHING LEFT LEG BETWEEN TWO FIXED OBJECTS		Hospital Entered WEST SIDE										
		First Treatment 6-17-26										
		X-Ray No. 28977										
		Final Reduction										
EXAMINATION		TREATMENT										
Bone LEFT TIBIA AND FIBULA		Closed Reduction YES										
Site JUNCTION MIDDLE AND LOWER THIRD		Method and Position of Fixation THOMAS SPLINT AND PLASTER CAST WITH WEDGING										
Type TRANSVERSE		Anesthetic Used Yes No										
Surface	X Transverse	Anatomical Result obtained PERFECT WEIGHT-BEARING LINE PRESERVED.										
Compound	Oblique											
Intra-test	Spiral											
Subperiosteal	Immersed	ONE HALF INCH SHORTENING										
Greenstick	Comminuted	Open Reduction										
Description of Deformity (original observing		Method and Position of Fixation										
MARKEED DISPLACEMENT OF FRAGMENTS WITH OVERRIDING AND SHORTENING.												
		Anatomical Result obtained										
Nature and Extent of Injury to Soft Parts (soft tissue and skin)												
CONTUSION OF SOFT PARTS		Was non-operative treatment tried first? Yes										
		How long after injury was operation performed?										
		Was internal fixation material subsequently removed?										
X-Ray		Why										
Before Reduction OVERRIDING		When										
After Reduction GOOD ALIGNMENT		Period of Complete Immobilization 3½ MONTHS										
At Discharge AMPLE CALLOSIS		Period of Protection 4 MONTHS										
Wassermann Test NEGATIVE		Total Period of Protective Treatment 4 MONTHS										
RESULT Arthromal Functional <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center; width: 33.33%;">Good</td> <td style="text-align: center; width: 33.33%;">Moderate</td> <td style="text-align: center; width: 33.33%;">Bad</td> </tr> <tr> <td style="text-align: center;">X</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">X</td> <td></td> <td></td> </tr> </table> Description of End Result: (Indicate Definite Shortening, Fixation, Pain, Swelling, Nerve) (a) At discharge from Hospital Date 9-30-26 PLASTER CAST, GOOD POSITION (b) At discharge from O.P.D. Date 2-14-27 DNE HALF INCH SHORTENING AND 10% RESTRICTED MOTION AT ANKLE. (c) At discharged date Date DISABILITY: ABSENT, PARTIAL, COMPLETE FOR SIX MONTHS MORTALITY Date Main cause of death Absence from work Duration SIX MONTHS *Ability to resume job *Present Wage earning capacity Compensation obtained: Yes? No? *Black Ink Surgeon's Opinion Red Ink Patient's Opinion				Good	Moderate	Bad	X			X		
Good	Moderate	Bad										
X												
X												

Form 19 (A.C.S. Case Record System)
Parke-Davis Company, Chicago

FIG. 526. Fracture record of case shown in Figures 520-525.

each day, increasing the number of throat sticks until angulation has been corrected and even to a slight degree overcorrected.

SIMPLE FRACTURES OF THE FIBULA

SYMPTOMS. The symptoms of simple fractures of the fibula are localized pain, muscle spasm, sometimes ecchymosis and seldom crepitus. Roentgenograms will confirm the diagnosis.

TREATMENT. A simple posterior molded cast should be applied for five to six weeks. Gradual weight-bearing may then be begun.

COMPLICATIONS. Occasionally in a low simple fracture of the tibia a fracture of the fibula will be found high up close to the neck; this may be overlooked unless the roentgenogram is taken to include this area.

PROGNOSIS. Disability will last for six to eight weeks. There is no specific loss of function.

CHAPTER XVI

INJURIES OF THE ANKLE

DISLOCATION OF THE ANKLE

SYMPTOMS. Dislocation of the ankle is usually backward, and occasionally lateral, but when lateral is sometimes accompanied by compounding. It is unusual to get this dislocation without fracture of the inner malleolus of the tibia. The symptoms include marked distortion of the foot, with the lower end of the tibia prominent in front or dorsally, a plantar extension of the toes, effusion about the ankle, definite muscle spasm and limitation of motion. There is absence of crepitation. The roentgenograms show the lesion plainly.

TREATMENT. The best method is generally reduction under anesthesia, although sometimes reduction can be performed after the administration of morphine, scopolamine or a local anesthetic. It can be accomplished simply by grasping the toes with the left hand and the heel with the right hand, then hyperextending the toes, pulling from the shaft of the tibia at the same time that the tibia is being pushed down by an assistant, following by dorsal flexion of the toes.

When the dislocation is lateral reduction by the closed method may prove impossible. The open technique as described for the reduction of a dislocated astragalus (p. 373) should then be used.

After reduction, an ankle splint (Fig. 527), which I have devised, is applied. This splint permits early motion as well as early healing of the tissues. Motion can be started three to four days after the application of the splint. The splint is left on for five or six weeks, and every other day passive and active massage is done. Gradual weight-bearing is begun ten weeks after the accident.

Some of these patients suffer from a relaxation of the ankle after weight-bearing is begun. It is then advisable to strap the ankle, to study the nature of the weight-bearing, and, where there is a tendency to pronation, to apply a Crook's heel or a Dutchman, or both, for three months, or a molded plate in the shoe. If, at the end of three months, the ankle still shows preternatural play, I continue

the support, and at the same time stimulate the musculature by having the patient rotate both feet and describe a circle with the great toe; in conjunction with this movement I have him stand on

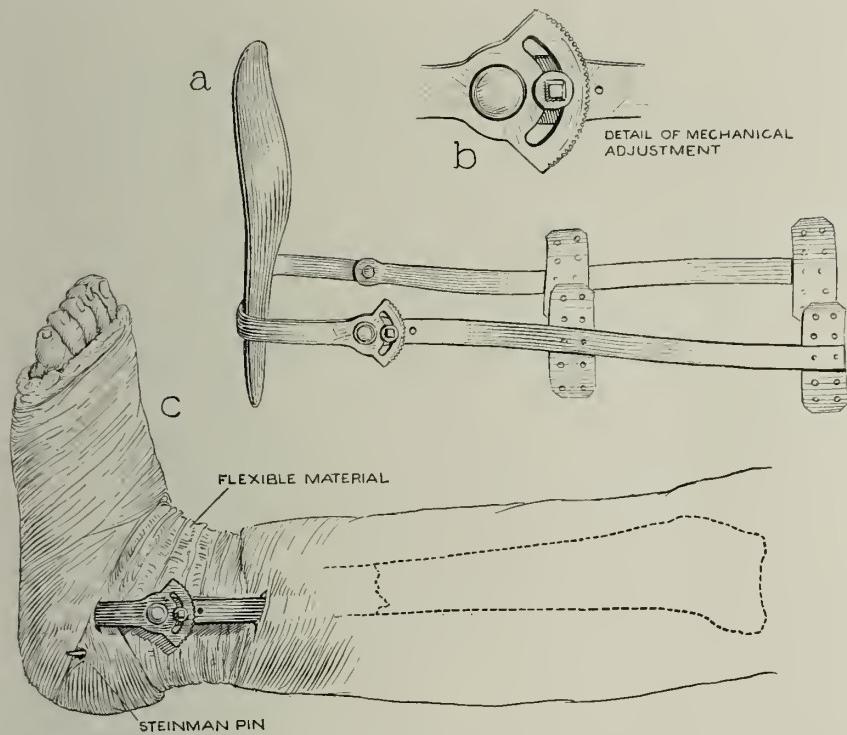


FIG. 527. Author's splint for fractures into ankle joint, associated with Steinman pin for fractures in shaft.

the floor with both feet turned in, rising up and down on the toes as many times a day as possible without overtiring himself. Both of these methods serve to strengthen the plantar and leg muscles.

PROGNOSIS. Disability will be four to six months.

SIMPLE DISLOCATION OF THE ASTRAGALUS

SYMPTOMS. The symptoms include marked deformity, manifested by inversion of the foot, and an irregular prominence externally or below the external malleolus. There are effusion, ecchymosis, and marked pain and spasm with rigidity of the foot. The bottom of

the foot usually points toward the uninjured foot, due to marked angulation at the point of dislocation. There are limitation of motion on eversion and increased motion on inversion. One can feel a hard

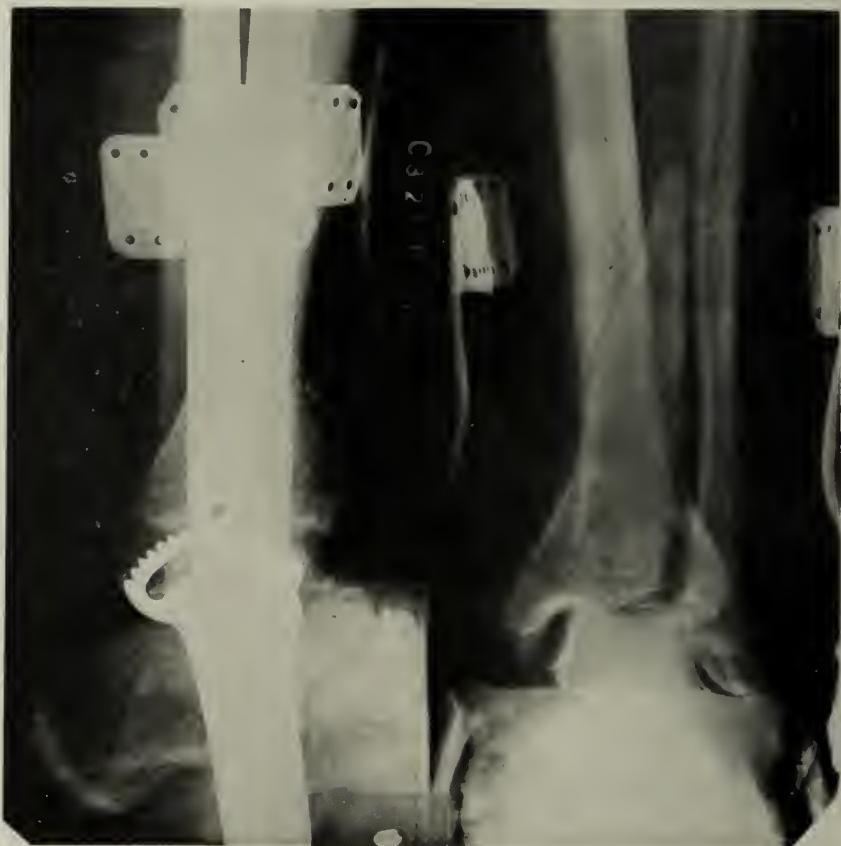


FIG. 528.

FIG. 529.

Figs. 528 and 529. Author's special hinge joint splint incorporated in plaster for early motion of ankle joint, used particularly where fracture involves articulation of the ankle joint.

bony substance under the skin at the outer side of the foot under the fibula.

Occasionally there is marked whitening of the tissues, due to pressure of the dislocated bone on the soft parts. Anteroposterior and lateral roentgenograms define the lesion clearly. The anteroposterior roentgenogram is not so likely as the lateral to depict the dislocation

clearly. In my experience the dislocation is always outward. I have never seen a dislocation of the astragalus inward.

TREATMENT. It is very difficult to reduce this dislocation at the



FIG. 530.

FIG. 531.

FIGS. 530 and 531. End-result after use of ankle splints.

time of injury, because of the effusion, the swelling of surrounding tissues, the distortion and the marked change in the bony anatomy and because the astragalus has five articular facets. It is advisable, however, to reduce the dislocation immediately, because delay causes a pressure necrosis of the tissues, which is followed by sloughing.

It is next to impossible to reduce this dislocation by any other method than open operation, even if a general anesthetic is given. I have had only one case that I have been able to reduce without



FIG. 532.

FIG. 533.

FIGS. 532 and 533. Author's hinged joint splint incorporated in plaster for early motion at ankle joint.

surgical interference. The method of closed reduction which I followed in this case included hyperinversion of the foot, with pressure on the astragalus from the outer side followed by extension of the foot in inversion, and finally gradual eversion.

The open method of reduction demands careful preoperative preparation. The limb is shaved and washed with soap and water,

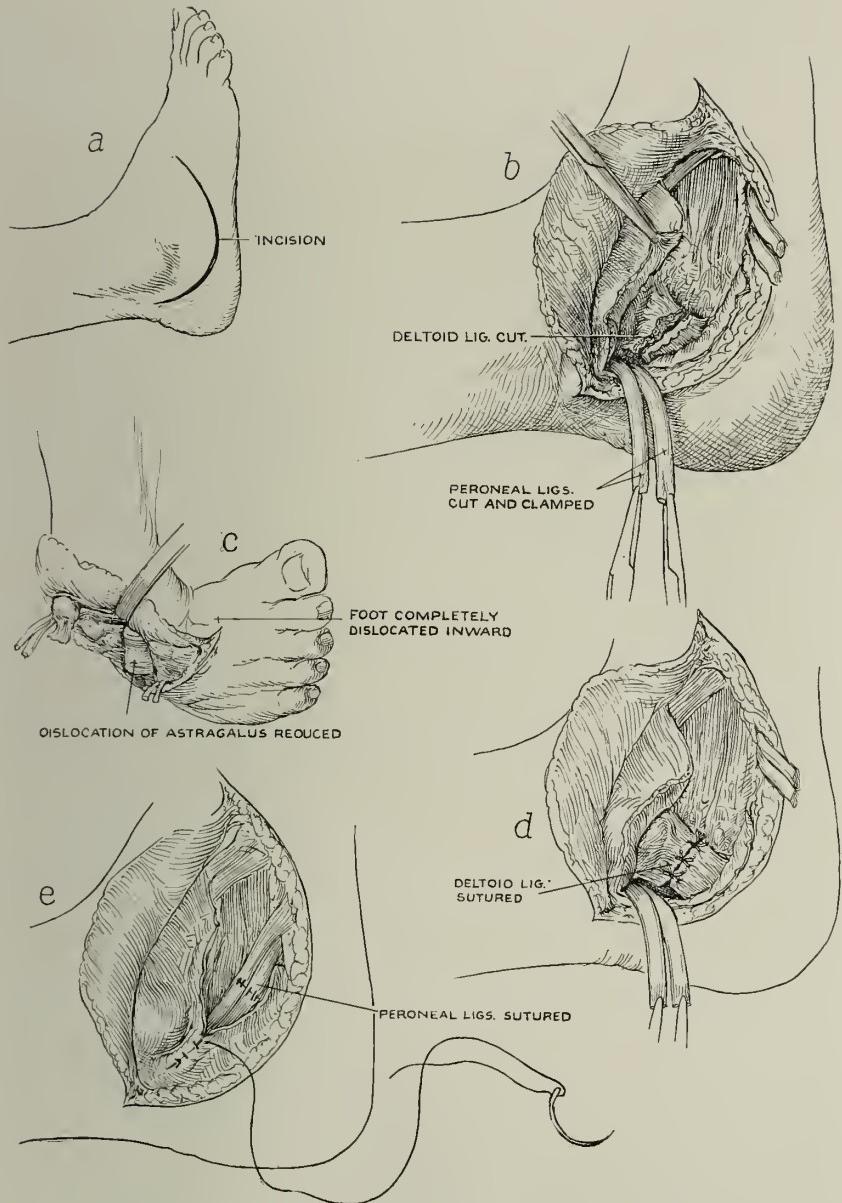


FIG. 534. Operation for reduction of dislocated astragalus.

then plain water, drenched with ether, and finally painted with iodine or mercurochrome.

The ideal method of approach is by means of the Whitman incision (Fig. 534), used by Royal Whitman of New York for astragalectomy in children. I have seen cases in which the surgeons who had not made this type of incision had removed the entire bone when they found they could not accomplish a reduction.

The Whitman incision permits of excellent exposure of the ankle. In the adult who is well developed muscularly, however, it may be necessary also to sever the peroneus longus and brevis tendons. If this is done forceps should be attached to each one of the proximal ends, to prevent the tendons from retracting up the sheath. Reduction is then comparatively easy, particularly if close attention is paid to the position of the various articular surfaces of the bone. The foot may be hyperinverted until it is practically at right angles to the shaft of the tibia, and then the bone can be manipulated into place with little or no force.

Following the reduction the tissues are drenched with an iodoform and ether solution (14.78 c.c. of sterilized iodoform to 59.15 c.c. of ether). The ligaments of the ankle joint are then repaired by passing a medium kangaroo tendon from the external malleolus in the ligamentous substance down to the remaining structures of the capsule. It is not always possible, because of the tearing and destruction of the tissues caused by trauma, to differentiate the external lateral ligaments; but a kangaroo tendon suture inserted in such a fashion as to include all the remaining ligamentous structures provides sufficient support. The tendons of the peroneus longus and brevis are then sutured, using the method shown in Figure 534, the true tissues closed with silkworm gut, and plenty of padding applied over the incision. The padding is very important, because occasionally the traumatism, together with the dislocation, will produce a pressure necrosis of these tissues if they are not properly protected, and a disastrous sloughing may result.

A plaster cast is then applied, with the foot at right angles with neither inversion nor eversion, and is left on for at least two months. An opening can be made in the side of the cast seven to ten days after operation, and the sutures removed. At the end of two months the cast can be removed, and gradual passive and active massage

can be given. At the end of the third month weight-bearing with crutches may be started.

COMPLICATIONS. These include surgical infection, fibrosis due to focal or systemic infections, and faulty weight-bearing. One or more of these complications is likely to appear, so that the prognosis should be made with care. I have a case on record in which I operated successfully and estimated the disability period at four to six months. Six weeks after operation, the patient developed influenza and then a septic fibrosis of the ankle. A year passed before the man was able to work, and the ankle joint showed a permanent functional disability.

PROGNOSIS. The disability period in uncomplicated cases extends over at least six to eight months, and is usually followed by no specific loss of function. Prognosis, however, must be carefully guarded because of the great probability of complications, as mentioned. Even when the bone is completely dislocated it does not undergo any absorption or rarefaction on reduction if early massage and gradual weight-bearing are employed.

DISLOCATION OF THE ASTRAGALUS ACCOMPANIED BY FRACTURE

This form of dislocation is very apt to show one fragment displaced posteriorly, between the tendon of Achilles and the original articulation. The anterior fragment is displaced forward and outward, the fracture being through the neck of the bone anterior to the tibio-astragaloïd joint.

SYMPTOMS. This injury is followed by very marked distortion: pronounced eversion or inversion, usually inversion. There are restricted motion, marked rigidity of the entire foot, pain, spasm, effusion and discoloration. Tension of skin over the displaced bone is usually marked and tissue necrosis commonly follows if operation is not promptly performed. Roentgenograms are an excellent supplement to these symptoms in the making of a diagnosis.

TREATMENT. There is only one way to handle this form of injury, and that is by open operation. Even when one is of the opinion that he can reduce the condition without operation, it is advisable to obtain the patient's permission to use the open method if the closed method is unsuccessful so that the reduction can be completed at one sitting. It is useless to waste time trying to reduce this particular injury under the closed method; it simply cannot be done. The

patient should be placed under a general anesthetic, and the Whitman incision made, as in simple dislocation of the astragalus. Occasionally the peroneus longus and brevis tendons must be severed. The ankle joint should be freely exposed by hyperinversion and the bones then manipulated back into position. Reduction is not easy, because, as a rule, when this injury occurs there is a twisting of the posterior fragment that makes the task of replacing it in its normal anatomical position a difficult one, and if one is not acquainted with the osteology, doubly difficult.

After reduction the treatment is identical with that followed in simple dislocation. No wiring or suturing of the reduced fragments is necessary. The cast should remain on for at least eight weeks, and after its removal passive and active motion, massage, diathermy and muscle education of all groups should be practiced. The removal of the cast is governed by the degree of union as shown by the roentgen rays. When weight-bearing is started, three to four months after operation, a shoe with a Crook's heel and a Dutchman should be used temporarily. The patient should try to develop the plantar muscles, by turning the toes in and then balancing up and down on his toes, two or three times daily. Sometimes it is necessary to use a metal arch plate instead of an orthopedic shoe.

PROGNOSIS. The prognosis must be guarded in this form of injury, because there is likely to be a loss of circulation in one or both of the fragments, with atrophy of the bone and change in shape, causing faulty weight-bearing. Even when there is no interference in the circulation and no definite bone change, weight-bearing must be practiced so gradually that a disability period of at least eight or nine months to a year should be anticipated.

There is no occasion for the removal of one or other fragments, providing the approach is made as described and in accordance with a competent knowledge of anatomy and osteology and bruising of the structures is avoided.

COTTON'S FRACTURE OF THE ANKLE

This not uncommon industrial injury, which is very carefully described by Cotton,* is caused by a splitting-off of the posterior articular edge of the tibia, usually to a third or a half of its depth.

* Cotton, F. J. Dislocations and Joint Fractures. Ed. 2. Saunders, Phila., 1924.

SYMPTOMS. The symptoms include slight posterior displacement of the astragalus on the tibia. There are present pain, spasm, swelling and loss of motion in flexion and extension. The roentgen rays supplement these symptoms in the making of the diagnosis.

TREATMENT. The treatment as advocated by Cotton is a practical one; but I have made changes in his method in my own cases, particularly when the posterior fragment shows great upward displacement. In cases in which the cortex of the bone is strong, as shown by roentgenograms, I insert a Steinman pin in the heel for a period of three or four weeks, thus producing traction and drawing down the displaced posterior fragment.

I have never yet had any complications following the use of the Steinman pin. Occasionally the hole through the bone has been a little slow in healing, but since I have been using an irrigation fluid composed of 14.78 c.c. of powdered iodoform to 59.15 c.c. of ether, this condition has been entirely remedied. The main precaution to be observed is to be sure that the cortex of the bone is strong.

When the Steinman pin is used, 5 to 10 lbs. of weight (not over 15 lbs. should ever be used) with the foot in the position of hyperdorsal extension, usually provides sufficient traction. The pin need not remain in position more than four to five weeks. At the end of this time passive motion may be begun, followed by massage and active motion, and gradual weight-bearing eight to ten weeks after injury. These cases are sometimes benefited when they begin weight-bearing by the use of a Crook's heel. In spite of treatment, the patient may suffer some permanent functional disability.

COMPLICATIONS. Occasionally cases occur in which there is a partial fracture of the anterior portion of the tibia, with a projection of the bone downward, forward and against the astragalus. This deformity prevents dorsal flexion. When such cases are of long standing, the only correction is incision in front of the ankle joint and removal of the projection, unless the condition is recognized early and is reduced by placing the foot in a cast in dorsal flexion.

PROGNOSIS. The disability period lasts from four to six months in uncomplicated cases. The patient suffers some permanent specific loss of function.

CHAPTER XVII

INJURIES OF THE FOOT

ACUTE FRACTURE OF THE OS CALCIS*

THIS injury occurs more frequently than is commonly realized and, unless some attempt is made to treat the case in an intelligent way, leaves the patient crippled and unable to pursue a vocation demanding much physical activity.

Physicians sometimes consider this injury as of a distinctly minor nature, and persist in following a useless routine line of treatment. I find that it is almost a universal rule for the physician who treats this condition to take roentgenograms, make his diagnosis and apply a plaster cast with no idea of the correcting of the deformity or of weight-bearing.

This fracture, in industrial workers, results more often in prolonged disability and permanent loss than does fracture of almost any other bone or bones because of lack of attention to proper methods of treatment and because of a more definite number of these injuries. In spite of all efforts, to be sure, some of these patients suffer permanent disability; but in the vast majority of cases, if care and attention are given to the initial treatment, the patient should be left with a limb of excellent functional capacity.

The injury is practically always caused by a direct fall, the patient coming down on one or both heels in the standing position, on a hard surface, such as a concrete floor. Occasionally crushing injuries produce this fracture.

The patient need not have fallen a great distance; 8 to 10 feet is sufficient, since the position in which the patient strikes the ground has much to do with the causation of the fracture.

SYMPTOMS. The symptoms include immediate disability, swelling, effusion and discoloration of the tissues about the ankle joint, with a definite widening of the malleolar arch; also pronounced pain

* Cotton, F. J. Dislocations and Joint Fractures. Ed. 2. Saunders, Phila., 1924.

Scudder, C. L. The Treatment of Fractures. Ed. 10. Saunders, Phila., 1926.

Baetjer, F. H., and Waters, C. A. Injuries and Diseases of the Bones and Joints. Hocber, N. Y., 1921.

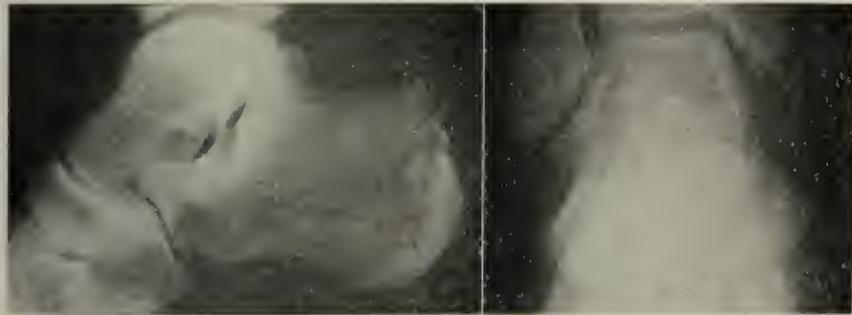


FIG. 535.
FIGS. 535 and 536. Longitudinal fracture of os calcis.

FRACTURE RECORD					
Name	J. T. B.	Address		Case No.	33413
Age	51	Sex	M ♂	Date	-
Occupation				Dr.	-
Cause of Fracture	LEFT FOOT MASHED BETWEEN STEEL WORK AND TIMBER			Time of Occurrence of Accident	11-5-21
				Hospital Entered	
				First Treatment	
				X-Ray No.	
				Final Reduction	
EXAMINATION		TREATMENT		RESULT	
Bone	LEFT HEEL	Closed Reduction	WOUNDS SUTURED AND CAST	Good	Moderate
Site		Method and Nature of Pressure APPLIED		Bad	
Type	LACERATIONS AND SEVERE CONTUSION	Anesthetic Used	Yes No	Anatomical	Functional
		Anatomical Results obtained		Description of End Result, including Deformity, Shortening, Function, Palp, Swelling, Nerve	
Cosmetical	Oblique	1-11-22 CAST		(a) At discharge from Hospital Date 2-27-22 ASKED	
Intra-Joint	Spatial	WORN ABOUT 6 WEEKS, NOW BEGINNING TO BEAR SOME WEIGHT ON MEMBER.		TO RETURN TO WORK, SOME SORENESSTILL IN ANKLE REGION. NO LIMITATION	
Schmorl's	Increased			IN ANTERIOR-POSTERIOR MOTION OF	
Groenewold's	Commissured	Open Reduction 2-10-22 MOTION IN ANKLE		ANKLE.	
		Method and Duration of Pressure "VERY GOOD"		(b) At discharge from O. P. D. Date	
Description of Deformity including shortening					
Anatomical Results obtained					
Nature and Extent of Injury to Soft Parts especially nerves and vessels					
(c) At subsequent date Date					
Was non-operative treatment tried first?					
Disability: Absent Partial Complete FUNCTIONAL LOSS					
OF FOOT APPROXIMATELY 25%.					
How long after injury was operation performed?					
Was internal fixation material subsequently removed?					
x-Ray					
Before Reduction	FRACTURED OS CALCIS				
After Reduction	Why When				
At Discharge	Period of Complete Immobilization				
Wassermann Test	Period of Protection				
	Total Period of Protective Treatment				
	Mortality Date				
	Main cause of death				
	Absence from work Duration				
	Ability to resume job				
	Present Wage earning capacity				
	Compensation obtained Yes? No?				
*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion					

* Form 19 A.C.S. Case Report System
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FIG. 537. Fracture record of case shown in Figures 535 and 536.

upon pressure below the external malleolus, loss of the power of inversion or eversion, and pronounced muscle spasm, especially over the peroneal muscles. There is seldom crepitation, because the



FIG. 538.



FIG. 539.

Figs. 538 and 539. Comminuted fracture of left os calcis, showing importance of dorsal view to demonstrate comminution of anterior portion of os calcis.



FIG. 540.



FIG. 541.

Figs. 540 and 541. Right foot of same case as Figures 538 and 539, showing fracture through neck of astragalus. (See chart, Fig. 542.)

usual fracture is impacted. Objectively there is a shortening of the long axis of the bone and a drawing-up of the distal fragment.

Roentgenograms are of inestimable value in making the diagnosis, and both anteroposterior and lateral views should always be taken. The anteroposterior view is necessary in order to show the

INJURIES OF THE FOOT

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crushing of the bone below the external malleolus; the lateral view shows impaction and flattening of the longitudinal arch.

TREATMENT. The patient should be kept at rest in bed until all

FRACTURE RECORD					
Name C. J.	Address				
Age 38 Sex M M 4	M 98932	White or Colored WHITE	Time Occurrence of Accident 1:30 P.M. 12-7-25	Case No. 65843	
Occupation SHEET METAL WORKER			Hospital Entered ST. ELIZABETH'S	Date 12-7-25 P.M.	
Cause of Fracture FELL 14 FEET AND LANDED ON HEELS			First Treatment 12-8-25	Dr. FORRESTER A. LITMAN	
		X-Ray No.	Final Reduction 12-15-25		
EXAMINATION		TREATMENT		RESULT	
Bone BIGET AND LEPT OS CALCIS		Closed Reduction TENOTOMY OF TENDON OF ACHILLES	Method and Position of Fixation FRAGMENTS MOLDED INTO CORRECT POSITION	Good ✓	Moderate
Site FOOT		Anesthetic Used Yes ✓ No	Anatomical Result obtained EXCILIENT	Functional	Bad
Type:				AT NO LOSS FOOT	
Scars	Transverse			Description of End Result LT. 15% LOSS FOOT including Deformity Shortening, Pinched Pain, Swelling, Nerve	
Compound	Oblique			(a) At discharge from Hospital Date 12-18-25	
Intra Joint	Spur			REMOVED IN AMBULANCE FIXED DRESSINGS	
Schabergen	Involved			STILL INTACT	
Cruscius	Comminuted				
Open Reduction		Method and Position of Fixation			
				(b) At discharge from O. P. D.: Date	
Description of Deformity including shortening					
TENDENCY TO A FLAT FOOT OR FORCED EVESION OF FOOT					
		Anatomical Result obtained			
Nature and Extent of Injury to Soft Parts especially nerves and vessels					
MODERATE TRAUMATISM TO AS CO. SOFT TISSUE		Was non-operative treatment used? Yes		(c) At subsequent date Date	
NO NERVES OR VESSELS INJURED		How long after injury was operation performed?		Disability AbSENT Partial Consider	
		Was interval fixation material subsequently removed?		COMPLETE RECOVERY RIGHT FOOT 15% LOSS FUNCTION LEFT FOOT	
X-Ray		Why		Mortality NO Date	
Before Reduction YES		When		Main cause of death	
After Reduction YES		Period of Complete Immobilization		Absence from work: Duration (6-21-25) 7 MO 14 DAYS	
At Discharge YES		Period of Protection		Ability to resume job 6-24-26	
Wassermann Test EO		Total Period of Protective Treatment		Present Wage earning capacity FULL	
				Compensation obtained Yes? ✓ No?	
				Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion	

Form 151 A.C.S. Case Record System
Revised Form January, 1926

FIG. 542. Fracture record of case shown in Figures 538-541.

effusion has subsided, leaving the bony deformity prominent. This will require a week or ten days. Ice bags or hot applications will prove helpful. The foot should then be prepared, from the knee down, as for a major surgical operation. Under general anesthesia two subcutaneous incisions, 3 inches apart and anterior to the Achilles tendon, are made with a tenotome. Then with a slight sawing motion half of the tendon is severed on one side and half on the other side, lower down. A jerking of the foot serves to stretch the severed tendon. This stretching takes away the pull from the os calcis, so that it can be manipulated into proper alignment. The impaction should be broken up if it interferes with the pulling down of the point of the heel. Using the short handle of a garden mallet and

following the groove below the external malleolus, the surgeon, by using another mallet as a hammer, can impact the fragmented bone below the external malleolus back into position. In this way

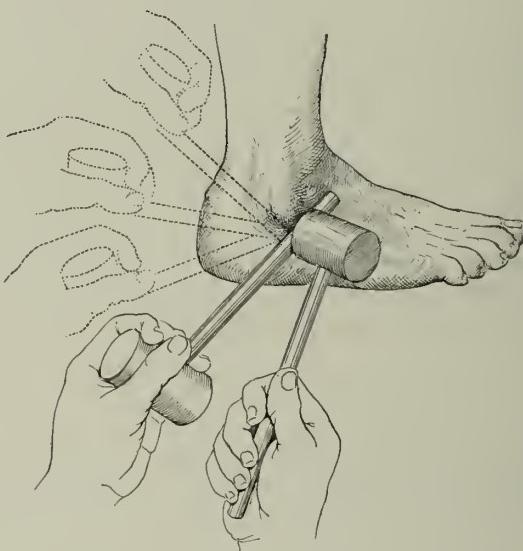


FIG. 543. Molding below external malleolus in acute os calcis.

the contour below the external malleolus can be made as nearly normal as possible.

It is advisable to prepare the normal limb as for operation, so that, by comparing it with the injured limb, the surgeon may determine to what extent the groove should be reestablished in the fractured heel.

A hard roller bandage should then be unwound until it is only $\frac{1}{2}$ inch thick. This is hammered flat, placed over the new groove on the external malleolus and held there with adhesive. The foot is then slightly inverted and flexed at right angles, and another bandage, about $\frac{1}{2}$ inch thick and 3 inches long, is placed transversely across the plantar arch and retained there with adhesive. A plaster cast is applied from the toes to the middle of the leg, with the foot still flexed at right angles and slightly inverted, with the ball of the great toe flat and the heel slightly inverted.

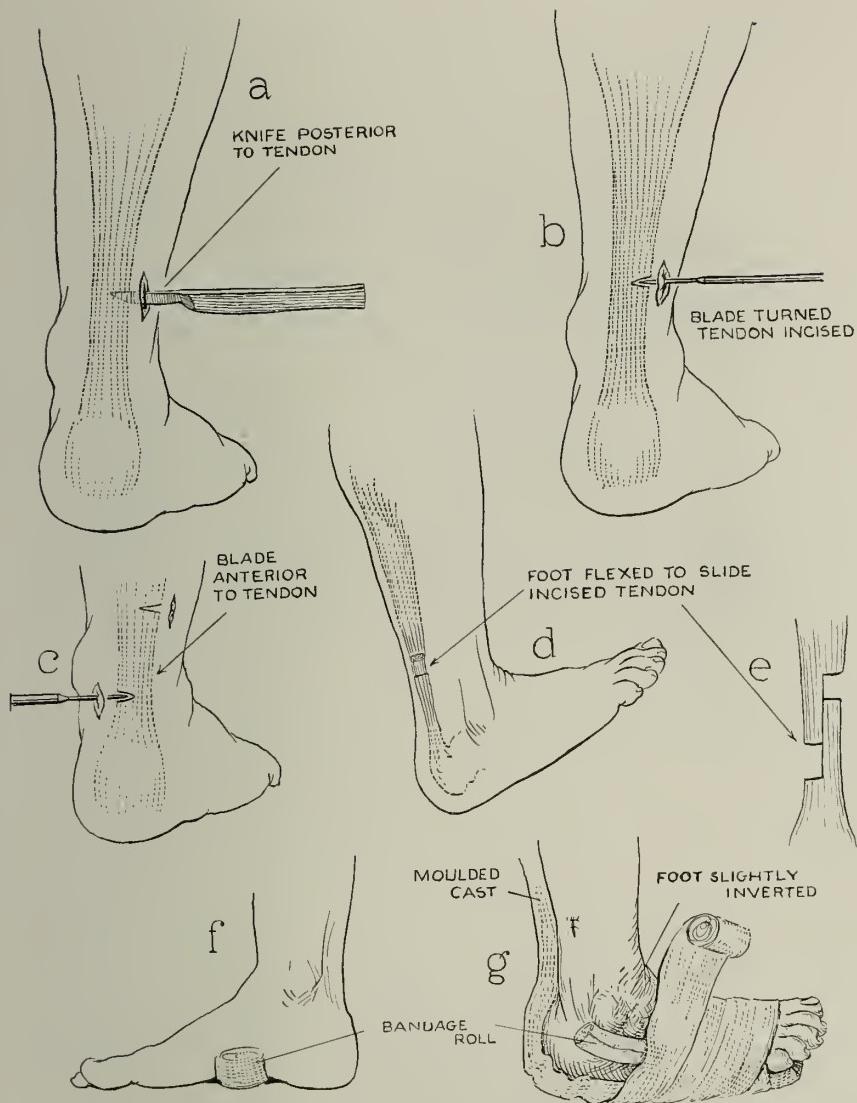


FIG. 544. Correction of acute os calcis.

The cast is kept on for at least seven and preferably eight weeks. The mistake I used to make was in removing the cast too soon and in allowing weight-bearing before complete union had taken place,

FIG. 545.



FIG. 546.

FIG. 545. Bottom view of shoe for controlling weight-bearing of foot following fracture of os calcis. Note Crook's heel and Dutchman.

FIG. 546. Side view of shoe, showing raising of sole as well as heel.

FIG. 547. Anteroposterior view of shoe, showing weight-bearing line.



FIG. 547.

with the result that the patient developed a pronation of the foot, with a re-formation of deformed bone below the malleolus.

After the cast is removed a basket-weave adhesive dressing should be applied from the toes to above the ankle in inversion, and gradual weight-bearing begun. When it is possible, two or three weeks after removal of the cast, diathermy, together with intelligent massage, can be employed with beneficial results. In spite of this careful and prolonged treatment, patients sometimes complain of discomfort in the malleolar arch and below the external malleolus. In such cases a metal plate made from a plaster mold of the foot and worn inside the shoe sometimes brings relief, particularly in cases showing considerable deformity. In cases showing only slight deformity, a Crook's heel on the shoe proves helpful. Also the patient should practice various exercises. Sitting on the edge of the bed, with

shoes and stockings removed, he should describe a complete circle with the toes. This exercise serves to rebuild and strengthen the plantar muscles. Or he may stand with the toes turned in, and, with the assistance of crutches in the early stages, practice rising up on the toes. Numerous and varied exercises may need to be tried before a good functional result is obtained.

COMPLICATIONS. The usual complication in this form of injury is recurrence of the deformity below the external malleolus, with a tendency to pronation of the foot and fibrosis of the mediotarsal arch. This chronic form, which increases the usual disability period by at least two to three months, must receive the special treatment which is described on page 387.

PROGNOSIS. The disability period lasts at least six months, even in the uncomplicated cases; and disability periods of eight to nine months are not uncommon. I have known surgeons to estimate the disability period at from one to three months. Such estimations are obviously ridiculous.

CHRONIC FRACTURE OF THE OS CALCIS

Chronic fracture of the os calcis is due to improper treatment by a physician who does not appreciate the seriousness of the injury, or occasionally to the unavoidable development of complications even in cases that have been carefully treated.

SYMPTOMS. The patient complains of persistent pain on weight-bearing, through the mediotarsal and malleolar arch, and below the external malleolus. There is definite pronation of the foot, from the first to the third degree, with thickening below the external malleolus and shortening of the long axis. There is also definite limitation of lateral motion which at best is only slight, but usually no limitation of motion during flexion or extension. There is pain on pressure below the external malleolus over the deformity. The patient usually walks without discomfort on a level surface, but when he steps on any small object, such as a pebble or a piece of wood, producing severe eversion, he suffers such pain that he is obliged to stop, or he may even fall to the ground.

Roentgenograms are an excellent supplement to these symptoms in the making of a diagnosis. Both lateral and anteroposterior views should be taken, with the heel resting on the film and the toes point-

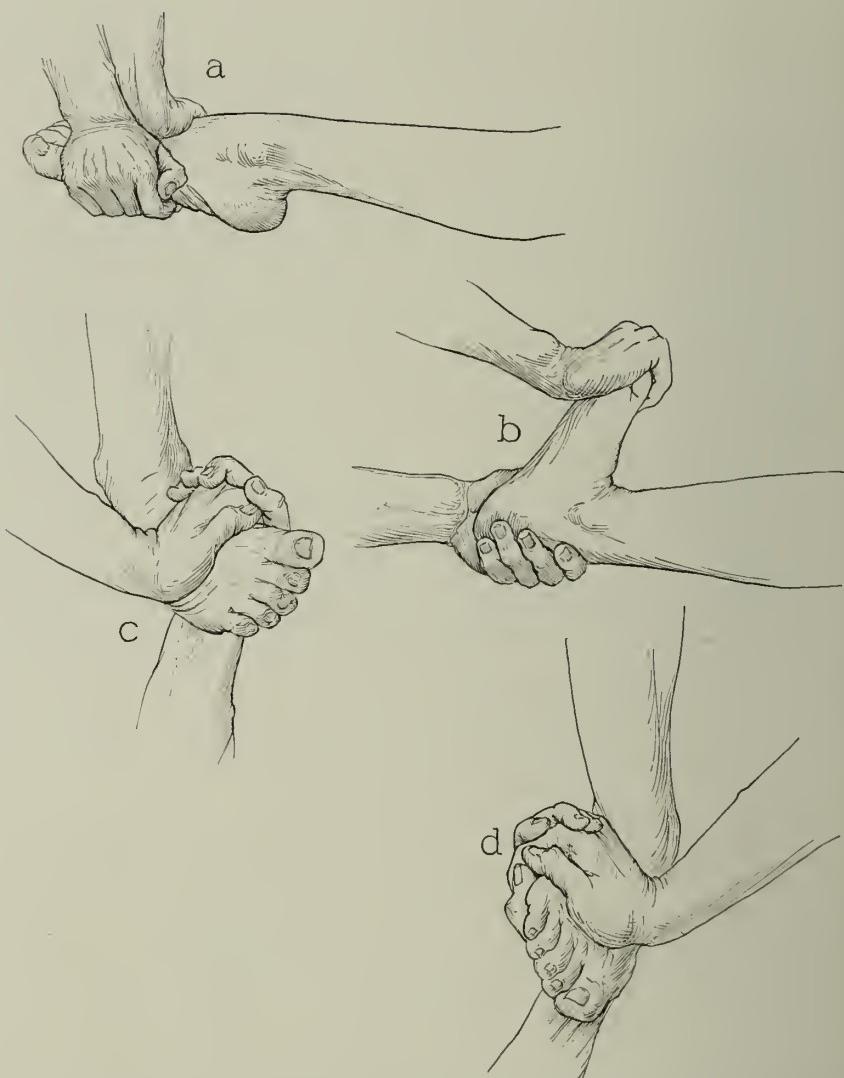


FIG. 548. Method of wrenching fibrosed feet before correcting weight-bearing or chronic os calcis.

ing toward the tube in order to show the deformity below the external malleolus. In addition, one should be made extending through the back of the heel.

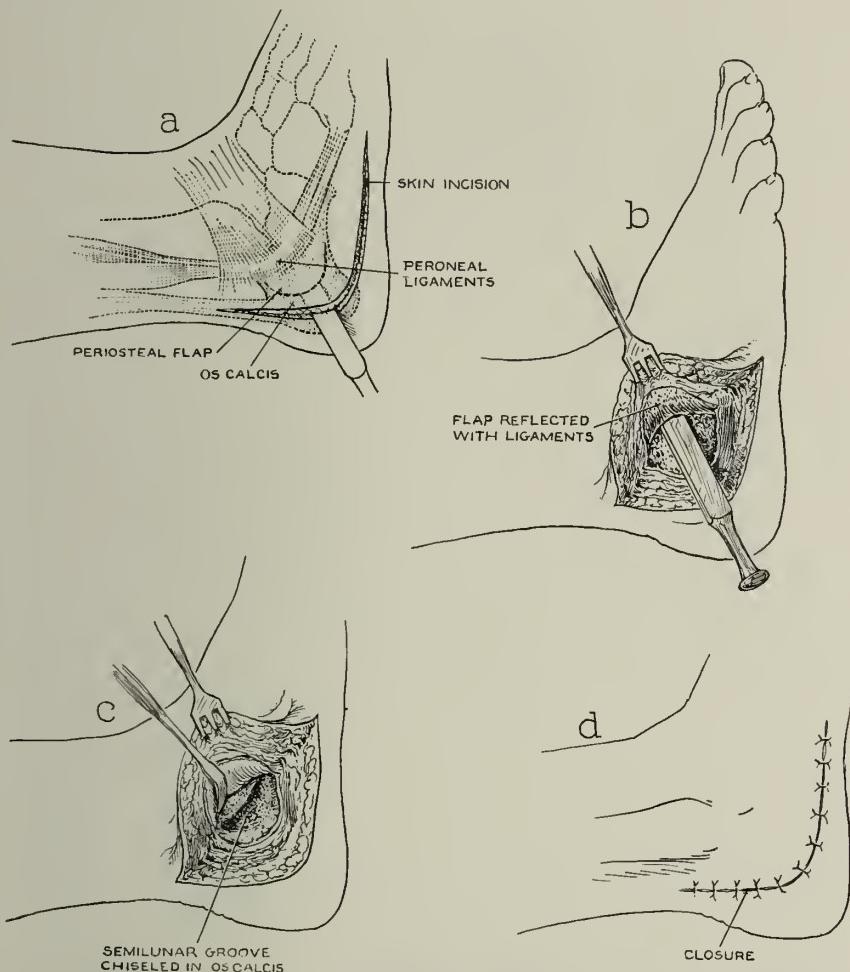


FIG. 549. Operation for correction of chronic os calcis fracture to be used in connection with wrenching of foot.

TREATMENT. I have found only one satisfactory method of treatment for these cases. The limb, from the knee down, should be prepared as for a major operation. The patient should be placed on his side, with the external malleolus pointing upward. Before any

surgical work is carried out, a forcible wrenching on the foot should be done (Fig. 548) and all the adhesions through the mediotarsal arch broken up, so that this portion of the foot becomes entirely flaccid.

An incision is made on the outer side of the foot slightly anterior to the Achilles tendon, down and around the ankle, forward to the attachment of the peroneus brevis. This incision should be carried down to the bone. With a chisel a subperiosteal resection is made in an upward direction raising the sheath of the peroneal tendons with the periosteum and even removing temporarily the attachment of the lateral ligaments of the ankle joint. Scudder, in his "Treatment of Fractures" shows a similar operation which I have tried. It may be that I do not understand his technique, although I have tried to follow it, but I have had adhesions about the peronei which later on became painful; whereas a sub-periosteal dissection removes this postoperative complication. As will be seen, my incision is carried much lower on the heel than his, allowing of the tendons being raised with the ligaments; and even though the ligaments are changed in their ultimate attachment the function seems not to be impaired.

Following this an oval portion of the os calcis should be removed, consisting of that part of the bone causing the deformity, and the tissues should be dropped back in position and sutured with one deep silkworm suture only. The same type of dressing used in the acute form (Fig. 544) should be applied and the same form of after-treatment should be followed.

PROGNOSIS. Even with the above method one must anticipate a certain specific loss varying with the degree of success and individual ability of the operator. Sometimes my patients have returned to work eight weeks after operation. Such a short disability period is the exception, however, and the surgeon should be conservative in his estimate in the average case of chronic fracture of the os calcis.

FRACTURES OF THE TARSAL BONES

This frequent injury may affect any one of the tarsal bones. It is caused, as a rule, by some heavy object falling on the foot, or by a crushing injury which produces torsion. Like fracture of the os calcis, it is occasionally the result of a fall.

SYMPTOMS. These include definite localized pain, inability to bear weight, swelling, effusion and a change in the contour of the

plantar arch as compared with the normal arch. Occasionally crepitation is present and also a change in the plantar arch, usually a flattening.

Roentgenograms, if they are to supplement these symptoms in the making of the diagnosis, should be taken straight through the dorsum of the foot as well as laterally, and the position of preference for the lateral view is with the outer side of the foot resting upon the film, in such a manner that a view may be taken at an angle. This will bring out the tarsal bones in better detail. On account of the peculiar formation of the tarsal bones and the various angles of articulation, very clear detail is imperative. Unless this is insisted upon, and unless the surgeon possesses a good knowledge of the articulations, an error in diagnosis is easily made, particularly at the tarsometatarsal junction.

TREATMENT. The treatment for this injury is simple. The chief point to observe is restoration of the arch and its maintenance during the healing process. A plaster cast should be applied and left on for at least six to eight weeks, preferably eight.

When one keeps in mind that this particular portion of the osseous skeleton supports the weight of the entire body, it stands to reason that immobilization of the fractured foot for a long period is imperative in order to avoid a breaking-down of the arch, a pronated foot and a painful, prolonged disability period. The foot should be immobilized at least seven to eight weeks.

After removal of the cast it may be advisable for a short time to place a metal arch in the shoe, or to change the shoe itself by the addition of a Crook's heel. In the application of a metal arch I am distinctly in favor of having this arch made from a plaster mold. One of two methods of obtaining a mold is used: (1) that of placing the foot in a pail of soft plaster; or (2), and this is the better method, the application of a thin gauze bandage to the entire foot, followed by a molding of two or three plaster bandages outside of this gauze bandage. While the plaster is hardening, the physician should accentuate the contour of the arch by supporting and molding it with his hand.

PROGNOSIS. The disability period in these cases lasts from three to six months.

DISLOCATION OF THE TARSAL BONES

SYMPTOMS. This injury, which is rare among industrial workers, is characterized by marked deformity at the point of dislocation, effusion, pain, occasionally ecchymosis and preternatural mobility. In some instances there is crepitation. Roentgenograms taken from various angles, particularly through the dorsum of the foot and laterally, serve to make the diagnosis clear.

TREATMENT. Reduction is done with the patient under a general anesthetic. After careful study of the nature of the dislocation, the surgeon should be able to work out the mechanics of the reduction before attempting any manipulation. A dislocation of any of the tarsal bones is usually dorsal. For that reason, in attempting reduction, the assistant should hold the limb above the ankle with one hand, and the operator should hold the toes and heel, and hyperflex the foot toward the plantar surface. The assistant should attempt to manipulate the bone back into position with his other hand, using his thumb, wedging it in between the two exposed surfaces; and while it is held in this position the surgeon should forcibly bring the distal portion of the foot up to its normal position in dorsal flexion, by means of slight lateral motion.

Following reduction, if it is obtained by the closed method, a cast should be applied and allowed to remain on for six weeks or longer, depending on the weight of the patient. Particular attention should be paid to the support of the arch during this period. Upon removal of the cast, the foot should be strapped during the early stages of weight-bearing, or should wear an arch plate inside the shoe for two to possibly three weeks.

With the best technique it is not always possible to reduce these dislocations by the closed method, in which event they must be surgically compounded. Open operation should not be performed for at least seven or eight days after injury, unless there is evidence of the dislocation producing a pressure necrosis of the skin.

Following open reduction, it will be found that by bringing the foot to right angles the open reduction will be maintained. There is no necessity for repair of ligaments, but a plaster cast should be applied with the foot in this position after the usual closure of the

FIG. 550.



FIG. 551.



FIG. 552.



FIGS. 550-552. Fracture of metatarsal.

skin tissues. This cast should remain on for at least seven to eight weeks. A shoe with an inside plate should be worn for two to three months longer.

FRACTURE RECORD					
Name W.Z.		Address		Case No. ROB30	
Age 55	Sex M	M. S. W. D.	White or Colored	Date _____	Mr. _____
Occupation ROOFER				Dr. _____	
Cause of Fracture FELL 8 FEET FROM LADDER TWISTING RIGHT FOOT SEVERELY				Time of Occurrence of Accident 6-9-27	
				Hospital Entered	
				First Treatment	
				Final Reduction	
EXAMINATION		TREATMENT		RESULT	
Bone FRACTURE 5TH METATARSAL	Closed Reduction	Anatomical Used	Yes	No	Good
Site PROXIMAL ARTICULATION	Method and Position of Fixation	Moderate			
Type		Bad			
Simplici	Traumatic	Description of End Result, including Disability, Shortening, Function, Pain, Swelling, etc.			
Compound	Oblique	(a) At discharge from Hospital Date 8-13-27			
Intra-Joint	Small	DISCHARGED, WORKING FOR 3 DAYS,			
Subperiosteal	Incurred	ANKLE MOTION AS UNINJURED FOOT, ARCH			
Greenstick X	Comminuted	UNIMPAIRED.			
Description of Deformity (including shortening)					
SWELLING AND DISCOLORATION ABOUT THE RIGHT FOOT					
		(b) At discharge from O. P. D. Date			
Nature and Extent of Injury to Soft Parts (especially nerves and vessels)		Anatomical Result obtained			
		(c) At subsequent date Date			
		Disability: Absent Partial Complete			
		NO SPECIFIC FUNCTIONAL LOSS.			
X-Ray XES	Why	Mortality Date			
Before Reduction	When	Main cause of death			
After Reduction	Period of Complete Immobilization	Absence from work Duration			
At Discharge	Period of Protection	Ability to resume job			
Wassermann Test	Total Period of Protective Treatment	Present Wage earning capacity			
		Compensation obtained Yes? No?			
*Black Ink Surgeon's Signature Red Ink Patient's Signature					

Form 19 A.C.S. Case Record System
Print Name, County, State

FIG. 553. Fracture record of case shown in Figures 550-552.

PROGNOSIS. The disability period lasts for three, five and sometimes six months.

FRACTURE OF THE METATARSAL BONES

This common fracture may affect any of the metatarsals, and sometimes all of them, if the injury is a particularly violent one.

SYMPTOMS. Swelling, disability, crepitus, pain, change in gross appearance, sometimes considerable subcutaneous hemorrhage are present. Two roentgenograms, both dorsal and lateral, are necessary, because occasionally a dorsal view will show no bone change, while a lateral view will, and vice versa. Occasionally a first view will show nothing, but upon weight-bearing, the pain continuing, a subsequent one will show a definite displacement of bone.

TREATMENT. Formerly I applied plaster casts to these cases after reduction, but recently I have changed my treatment entirely and am now applying a simple basket-weave adhesive from the

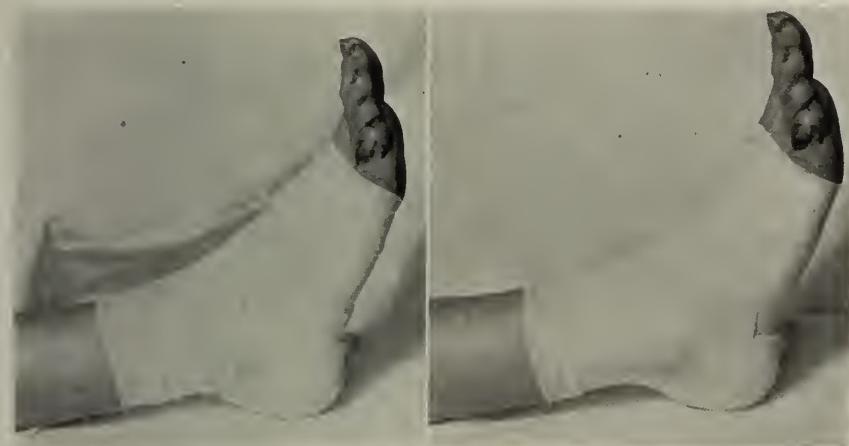


FIG. 554.

FIG. 555.

Figs. 554 and 555. Strapping of foot in fractured metatarsals or sprained ankle, showing application of gauze bandage first.

toes up to the ankle, and permitting the patients to go about on crutches immediately. Occasionally, when deformity accompanies fracture of one or more of the metatarsals, an open operation may be necessary, particularly when the first metatarsal is affected, because of its importance in direct weight-bearing. At the end of three weeks I permit these patients to begin a gradual amount of weight-bearing, and in the closed fracture, I renew the adhesive whenever necessary, whereas in the open reduction, I renew only in five to six weeks.

It is astonishing how markedly this method of treatment cuts down the period of disability. At the end of four to six weeks the patient walks with little or no complaint of pain or discomfort.

PROGNOSIS. The total disability period extends over six to eight weeks.

FRACTURE OF THE PHALANGES

These fractures are brought about by direct violence and are usually comminuted.

SYMPTOMS. These are swelling, effusion, pain on manipulation, and occasionally crepitation, ecchymosis and discoloration. Roentgenograms should be made in order to verify the diagnosis.

TREATMENT. The treatment is very simple and consists of a slight strapping of one toe to the next one, with the application of adhesive.

COMPLICATIONS. In these cases it is always advisable to take into consideration the age of the patient and the possibility of diabetes. A urinalysis should be made when the patient is over fifty years of age, and if he does not respond readily to treatment. Sometimes a bony union does not follow and an open operation for either open reduction or amputation is necessary. Here a local anesthesia, injecting a 2 per cent solution of novocaine with adrenalin, can be used, and the points of injection can be followed as outlined, depending upon toe or toes operated upon.

PROGNOSIS. The disability period extends over two to three weeks.

CHAPTER XVIII

THE TREATMENT OF COMPOUND FRACTURES

IN the treatment of compound fractures it is impossible to give any hard and fast rules, because no two cases are alike. A great deal of experience and surgical judgment are necessary before the surgeon can determine accurately the best method of treatment for each case.

As a result of experience acquired during the World War, and during a long period of specialization in emergency surgery, many of us have discovered that frequently badly fractured limbs can be saved, which, in the judgment of inexperienced physicians, require amputation.

PREOPERATIVE TREATMENT

In every case the surgeon should carefully examine the fractured limb before operation. He should then have a very frank talk with the patient, advising him of the intended attempt to save the limb. He should, however, obtain the patient's permission to perform amputation should the attempt to save the limb prove unsuccessful. When possible, *this permission should be obtained in writing*. In a great many instances the people treated by the traumatic surgeon are strangers to him. For various reasons they may institute legal action following an amputation for which their written consent has not been obtained. The patient's written consent, or, if the patient is under age, the written consent of his guardians, is a justifiable legal safeguard which every surgeon should try to obtain for himself.

The physician of limited experience is not justified in assuming the responsibility in the treatment of compound fractures. He should, for his patient's sake as well as his own, refer such cases to a surgeon of long experience in such work.

There are instances, however, in which an experienced consulting surgeon is not available and in which immediate operation must be performed in order to save life. In such cases every surgeon must, of course, be willing to operate.

Before operation, a thorough examination of the patient should be made to decide whether he is a good surgical risk. The condition

of the heart and lungs, and, if possible, of the kidneys, should be ascertained. The blood pressure should always be taken. If the patient is exsanguinated to the point where the surgeon's common sense tells him that an operation will be dangerous, treatment for shock should be instituted before performing an operation. An intravenous injection of normal salt solution with adrenalin or glucose, blood transfusion or any other restorative that the surgeon is in the habit of using, should, within a few hours after administration, build the patient up to a point where operation is justifiable.

OPERATIVE TREATMENT

Very detailed preparation of the limb for operation is unnecessary. Shaving and washing with soap and water, followed by ether, are sufficient, because the preliminary part of the operation consists in a careful dissection and removal of all badly traumatized tissues (*débridement*).

When muscles are detached and the circulation poor, it is advisable to *remove the muscles entirely*. When they have been simply torn in two and crushed, the traumatized portions can be clipped away and the remaining portions sutured together or to adjacent muscles, in order to preserve muscle balance as far as possible.

A careful examination of the nerves should be made. If severed, they must be sutured, particularly the mixed sensory and motor peripheral nerves (p. 414). There is no way to particularize for the reader the nerves to examine. Each injury calls for individual consideration, and the operating surgeon should be sufficiently conversant with anatomy to know what he is doing, and when not capable, he should turn the case over to someone better qualified. I mean by this that if a surgeon is going to handle a compound fracture, he should take a definite, *not* a half-hearted, interest in his case. He should exercise the same care, skill and diligence, even in the after-care, as in any other condition.

In reducing the fracture, the surgeon should employ the simplest technique, in order to prevent possible complications. Some surgeons prefer to use a Lane plate, others a bone plate or screws or wires. It is always advisable when using these to inform the patient that in all probability they will ultimately have to be removed and union may not take place.



FIG. 556.

FIG. 557.



FIG. 558.

FIG. 559.

FIGS. 556-559. Introduction of wire resulting in non-union of the radius. No evidence of any postoperative infection at any time. Wires removed and numerous holes drilled in bone to stimulate osseous union.

I am using the intramedullary beef-bone peg at present. This method is not altogether successful, although it acts as a fixation, holding alignment until callus forms. However, a sinus is likely to form later on, calling for removal of the peg before complete healing. I have discovered that in fractures of the radius and ulna, particularly, the introduction of such foreign bodies as screws or wires is often the cause of septic conditions, i.e., osteomyelitis. It is much better to establish an over-riding union followed by a normal period of convalescence than it is to strive for a classical union that may result in infection, vicious union and ultimate fibrosis, unless one is experienced in the use of artificial fixation.

After débridement is complete and before the fracture is touched, I recommend drenching all the tissues with a solution of sterilized iodoform and ether (14.78 c.c. of iodoform to 118.30 c.c. of ether). This solution may be used two or three times, if necessary, during repair of the fracture.

The tissues should be closed *without tension* and plenty of soft dressings applied. Drainage is advisable. *All bleeding points should be thoroughly controlled before closing.*

In cases of fracture of the lower extremities I consistently use a Thomas splint. In fractures of the upper extremity I generally use a Littler-Jones abduction splint, or a Jones aeroplane splint, or else I place a molded plaster cast on the forearm. It is impossible to outline any definite procedure, as the problems to be met with vary greatly in different cases, and the surgeon must use great judgment in making his choice as to procedure.

After operation, I do not disturb the patient for at least seventy-two hours, unless his condition absolutely demands interference. If débridement and the remainder of the operation are properly carried out, little interference is necessary during the three days following operation. Much of our work is utterly ruined by early inspections and changing of dressings. Nature can do wonders in many instances if we only give her a chance.

RESULTS OF TREATMENT

In any case of compound fracture prognosis should be guarded because of the great probability of such complications as infection

and delayed union. The disability period should be estimated at three to six months longer than that with simple fractures.

If infection occurs, it may be followed by shortening of the limb and also loss of motion in the immediate joint or joints, due to the permanent fibrosis resulting from prolonged immobilization and septic absorption. It is advisable, therefore, in immobilizing all fractures, to place the injured part in the position that will be most practical for use or weight-bearing, should fibrosis occur. For example, the wrist should be placed in a position of slight hyperextension, with the fingers flexed about 25 per cent from the normal. An elbow should usually be flexed to a right angle or slightly beyond, the position being governed largely by the patient's occupation. The shoulder should be placed in a position of abduction, as shown in Figure 49 demonstrating the Littler-Jones abduction splint. The hip should be placed in a position of abduction of at least 40° and more if possible. The knee should be flexed at an angle of 5° or 10°, but the ankle should always be placed exactly at a right angle.

CHAPTER XIX

SURGICAL INTERFERENCE IN THE TREATMENT OF FRACTURES

THIS is a very much discussed matter, and one on which surgeons differ widely. I believe that if a surgeon will take the time to study his cases properly, if he will handle each case as an individual problem, if he will develop a knowledge of muscle balance, and become adept in the use of mechanical appliances, he will not often resort to surgical interference in the treatment of fractures. This remark may seem peculiar in view of the many cases shown in which surgical compounding has been done. We have, however, been forced by the arbitrary stand taken by some of the industrial commissions to do more open surgery than formerly. If the commissions would judge conditions as is done under common law (functional ability to perform the same kind of work as before; not specific loss as between a normal and an abnormal structure) we would not feel obliged to do so much surgical compounding. It has been shown many times that after the commission has arrived at a specific penalty for the patient and he has received his award, he has gone back to and performed exactly the same work as before, earning the same salary. This is likely to be more often the rule than the exception.

In many cases which have come under my observation, surgical interference, instead of helping the patient, has created an immense amount of damage. In a number of these cases operation was performed only twenty-four to thirty-six hours after injury, and sometimes even sooner, which only added insult to injury; with the result that an infection followed, the patient suffering from long-drawn-out osteomyelitis and various types of deformities, with permanent loss of function. The injury itself naturally does a very serious amount of damage to the soft parts. If, then, operation is performed immediately, the almost inevitable results are traumatic sloughing, osteomyelitis and bone necrosis. *I never surgically compound a fracture until ten days to two weeks after injury, unless it is a question of life or death, or necrosis of tissue (an uncommon complication except in cases of dislocation of the astragalus).*

Any surgeon who contemplates doing bone surgery must be extremely careful in the preparation of his patient and of himself. As previously remarked, a bone surgeon must not *think* he is surgically clean; he must *know* it.

THE USE OF FOREIGN MATERIAL IN THE FIXATION OF BONE

In cases of surgical interference, the surgeon should consider thoroughly his procedure before operation; during operation he should refrain as far as possible from the application of foreign material in the fixation of bone; for example, bone screws, wires, plates, wire nails, and ordinary metal screws. I have given up practically all such appliances except the sterilized intramedullary bone peg (either autogenous or beef-bone), kangaroo tendon and wire for the patella and olecranon and occasional bad fractures of the lower end of the humerus.

I have great faith in the efficiency of the intramedullary beef-bone method, as I have found it successful in practically every instance. If, however, the surgeon is convinced that wires must be used on a long bone, care should be taken not to encircle the shaft completely. Such a procedure interferes with circulation; and even though a successful reduction is made and no infection follows, cases in which this procedure is followed very often show non-union. The Parm band also causes injury by interfering with the circulation. When any foreign materials are used, it is advisable to tell the patient that in all probability they will have to be removed at some time after operation.

A perfect end-to-end, groove-to-groove apposition of a bone is unnecessary in order to obtain a good functional result. As emphasized in Chapter II, in a case showing a good functional result but imperfect alignment the patient should be shown the roentgen-ray films and the situation clearly explained to him.

INDICATIONS FOR SURGICAL TREATMENT^b

Two types of fractures, in my estimation, call for primary surgical treatment: complete transverse or comminuted fracture of the patella and complete transverse or comminuted fracture of the olecranon with separation. Occasionally, a simple oblique or spiral fracture must be surgically corrected. In long-standing cases of

non-union, operation must be performed. Marked shortening of the femur or tibia, amounting to more than $\frac{1}{2}$ inch, may, if the patient wishes it, be treated by surgical means, since closed methods

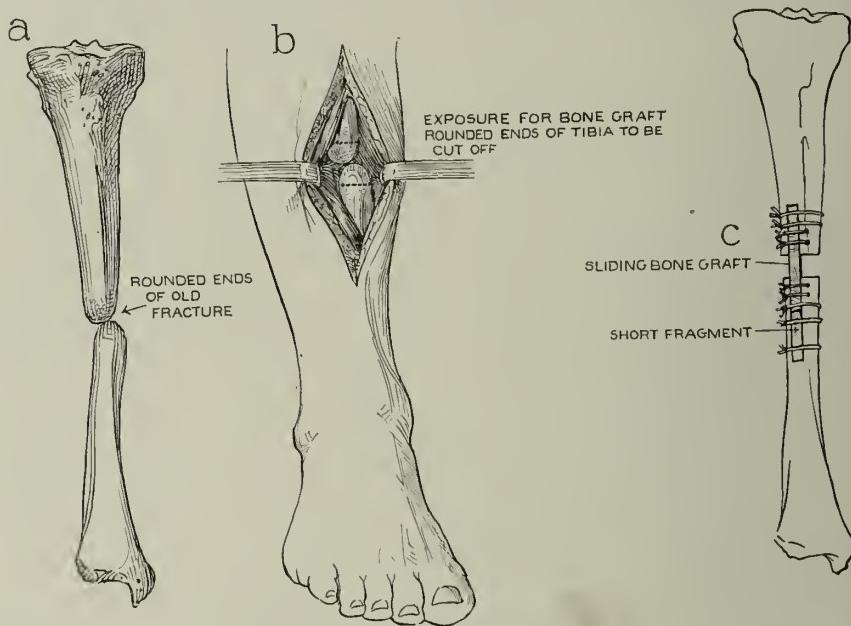


FIG. 560. Sliding bone graft for ununited fracture.

of treatment are usually of little avail in a patient showing great muscular development.

In instances of delayed union where the long bones are involved, a freshening of the edges with an intramedullary peg and a periosteal graft may be used, or a sliding bone graft of an autogenous transplant (Fig. 560) applied.

TWO IMPORTANT POINTS IN SURGICAL TREATMENT

It is absolutely impossible to lay down rules for a standard method of treatment in surgical cases, as every case demands strictly individual attention plus the individual surgeon's experience. Two points are of importance, however, in all cases:

First, in all cases of bone surgery, and particularly those involving the lower extremities, proper operative facilities, such as a Hawley table, are necessary in order to produce the necessary

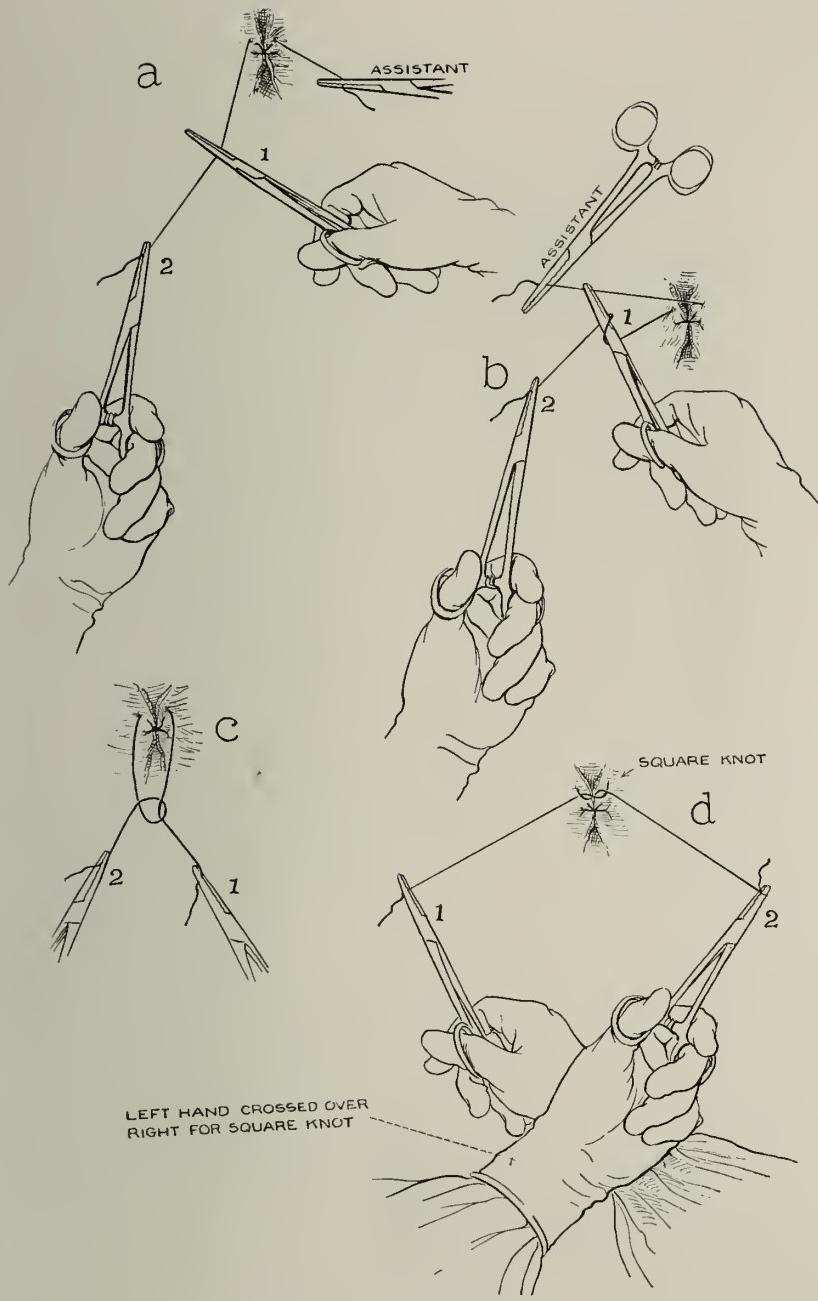


FIG. 561. Tying of knots without use of fingers.

traction and to assist in holding bones in apposition while appliances are put on. *The surgeon who operates without proper facilities runs a very grave risk of failure.*

Second, the surgical approach should *always* be done by sharp dissection along fascial planes. Ripping and tearing of structures should always be avoided and condemned. If careful dissection is carried out, postoperative healing is rapid and clean, and drainage is often entirely unnecessary. The careful control of all hemorrhage is also of great importance in hastening postoperative healing. Even sutures should be tied with instruments.

As implied in this chapter, whatever any surgeon may say to the contrary, Lane technique is imperative, and there is no excuse for the contrary, in the surgical compounding of bones. *Moreover, if proper time is given before surgically compounding with proper Lane technique the existing prevalence of osteomyelitis will be markedly reduced.*

CHAPTER XX

SURGICAL AND NON-SURGICAL TREATMENT OF INJURIES TO THE PERIPHERAL NERVES

IN including the treatment of peripheral nerve injuries in this volume, I have tried to make the section brief, direct and clear and at the same time to include the points which must be familiar to every physician attempting to treat an emergency condition.*

Many of our methods of diagnosis, and particularly of treatment and prognosis, have been changed as a result of investigations made during the World War. My year's association with the British during the War enables me to include in this chapter many points which are the direct result of the extensive experience of British practitioners in the handling of all types of peripheral nerve injuries.† Mr. Harry Platt of Manchester, England, has kindly put at my disposal his résumé of peripheral nerve work which I consider of inestimable value, particularly when it comes to prognosis. Practically the entire article is quoted as follows:

PATHOLOGICAL CONSIDERATIONS

THE PATHOGENESIS OF NERVE INJURIES. The characteristic pathological anatomy of the nerve lesions of warfare is now so widely known that it is unnecessary to do more than stress certain outstanding features.

In the vast majority of instances the nerve injury belongs to the "primary" class, and gross destruction with immediate loss of anatomical continuity is frequently seen. To the primary destructive effect of the missile is added the influence of a second potent factor—wound infection. Further destruction of nerve tissue now takes place in the course of the acute inflammatory reaction which follows. With the onset of the phase of healing and the production of young scar tissue, there is seen a still further obliteration of nerve substance. Finally, the scar tissue when fully matured has built up an impenetrable barrier which effectively prevents the growing axon of the proximal stump from obtaining access to the distal stump. These are the grosser mechanical results of wound infection. *But the nerve sustains a more insidious type of damage during the time that it lies bathed in the inflammatory exudates. Bacteria and their toxins pass into the interior of*

* For lengthy descriptions of the nerves the reader is referred to such writers as Benisty, Stookey, Tinel, etc. as this discussion is confined to surgery alone.

† For the surgical technique together with the different problems met with and described in this chapter I owe deep thanks to Mr. T. R. W. Armour of Liverpool, who was my chief at Alder Hey Military Hospital (Liverpool). I cannot express in words my appreciation of his patience in teaching me and of the opportunity he gave me while there of teaching others.

the nerve-trunk, and ascend for some distance above the limits of the initial lesion. The result is the development of an interstitial neuritis, the final histological picture showing a fibrosis involving the connective-tissue framework between the nerve bundles and around the individual nerve-fibres. Ascending neuritis of this type has been traced in injured nerves for many inches above the original lesion, and there is evidence to suggest that this process may occasionally reach the spinal roots. In the type of nerve injury in which there is little or no anatomical loss of substance, intraneuronal fibrosis in the proximal part of the nerve is often a dominating feature of the lesion. It is a well-established fact that an extensive interstitial neuritis exerts an inhibitory influence on the regenerative process; and further, if regeneration occurs, the symptoms of severe irritation may appear during the early stages of sensory recovery.

The fully matured lesion as seen during an exploratory operation represents a composite histological picture, to which the primary injury, the effects of wound infection, and the attempts at spontaneous repair on the part of the nerve have all contributed. A classification of lesions based on operation records alone can therefore have no exact anatomical or pathological basis. At the same time, a recognition of certain standard naked-eye appearances is useful for descriptive purposes. Broadly, we may recognize three main types: (1) Complete division with a gap; (2) Complete division without a gap—in this form the nerve-trunk retains a pseudo-continuity; (3) The nerve-trunk is apparently intact, but presents a wide variety of local alterations in contour, size, and consistence. A familiar example is the nerve "spindle" or fusiform "neuroma."

Peripheral Changes. The changes affecting the tissues to which the ultimate nerve-fibrils are distributed are of two types: (1) Simple disuse atrophy such as is seen best of all in the muscle bellies, and which is the direct result of the severance of axis cylinders (denervation); and (2) Trophic changes proper, which are dependent always on the existence of some form of irritation acting on vasomotor and sensory axons which still retain their integrity. The effects of irritation are exhibited in the evolution of a widespread fibrosis in the intramuscular connective-tissue planes and in the tendon sheaths and joint capsules—a familiar morbid picture in many of the gunshot injuries of nerves, and generally best marked in the hand. The intensity of these fibrotic changes is accentuated where gross infection has been present. It is to be remembered that similar fibrotic changes may follow obliteration of the main vessel of a limb even in the absence of a nerve injury (ischaemia). In long-standing nerve injuries, even where the influence of infection has been negligible and where irritative signs have been conspicuously absent, a certain degree of interstitial fibrosis in the denervated muscles may be seen. But under such conditions these muscles retain for long periods an anatomical structure which after re-innervation is not incompatible with function.

PRINCIPLES OF OPERATIVE TECHNIQUE

I. DIFFICULTIES IN EFFECTING REPAIR. The earlier phases of the peripheral nerve surgery of the war were to a large extent experimental, but operative methods soon became stabilized. The mechanical difficulties experienced in obtaining end-to-end apposition of the proximal and distal stumps in the case of the more extensive lesions brought into prominence for a time the question of the value of the methods of indirect repair—e.g., nerve-grafting, tubulization, etc.—procedures conveniently termed "bridge" operations. In this country an unbiased study of the results of the operations falling into this category soon showed that there was no justification for their continued inclusion in the repertoire of peripheral nerve surgery. With increasing experience the number of lesions found to be irreparable by the method of direct repair steadily diminished.

RESULTS OF OPERATIONS FOR THE REPAIR OF NERVE INJURIES: METHODS OF ESTIMATION

In judging the late results of operations for the repair of peripheral nerve injuries, it is necessary to make a clear distinction between two standards of assessment, the physiological or neurological, and the functional or economic. The former simply represents the amount of conductivity which has been restored to the nerve as measured by clinical and electrical tests. The latter, as the term would indicate, denotes the degree of general utility which the limb or part exhibits, apparently as the result of the operation. The two standards do not necessarily run on parallel lines. A good functional result may be seen in the presence of a poor neurological result; and, on the other hand, with a satisfactory or wellnigh perfect neurological result, there may be little improvement in the functional capacity of the limb. The reasons for such discrepancies are not far to seek. It is to be recalled that the effects of a complete lesion of a peripheral nerve may constitute little practical disablement in certain individuals. Thus, the elimination of the function of the intrinsic muscles of the hand in injuries of the *ulnar nerve* is of paramount importance only to those whose occupation demands the finer hand movements. One of the writers recently had the opportunity of examining a bricklayer under treatment for a wound of the leg who had sustained a complete division of the ulnar nerve at the wrist nineteen years before. He stated that his capacity for work had not been lessened by the wasting or loss of sensation in the hand. In lesions of the *median nerve*, the anaesthesia of the index finger is a far more serious disability, and impairs the capacity of the hand for most types of work.

Again, the loss of conduction and function due to a nerve injury may be overshadowed by the disabling effects of the consecutive or co-existing changes in other tissues. As already stated, the successful repair of the nerve, even if restoration of conduction and function go hand in hand, may then be of no practical value to the patient. Finally, in the absence of mechanical obstacles to the restoration of function, delay may be dependent on psychical causes.

Most of the available records are based on a neurological standard alone. For reasons which are sufficiently obvious, a survey of the economic or industrial capacity of large numbers of war-disabled men would to-day be an impossible task.

The operations which have been practised may be grouped conveniently into three classes: (1) *Operations for the restoration of conduction* (direct and indirect nerve repair); (2) *Operations for the relief of pain and other irritative phenomena*; (3) *Operations designed to restore function in irreparable lesions or in cases of incomplete recovery*.

STATISTICS

When an attempt is made to correlate the results recorded by different observers, we find that it is safer to avoid the massing together of mere statistics. It is more logical simply to present those broad conclusions which a study of a few typical series of operation results affords us. Before entering upon the latter task, we may quote briefly from some of the larger individual series of operations which have been published in this country during recent years. When compared with the number of operations actually performed in the various surgical centres, the published statistics are seen to be comparatively scanty. From such centres as the Special Surgical Hospitals at Shepherd's Bush and Tooting (London), and the Royal Herbert Hospital, Woolwich—centres in which exceptionally large numbers of operations were conducted by a small group of experienced surgeons—we have no figures. Much of the information, however, which appeared in the *Report of the Peripheral Nerve Committee of the Medical Research Council* issued in

1920 was founded on experience gained in these and other centres where it has not been practicable to follow up the more remote results on a large scale.

Kennedy (Glasgow) 1919:

25 operations on various nerves (civil injuries).

End-to-end suture—Complete success in 73 per cent; incomplete success in 26 per cent.

Neurolysis—Complete success in 70 per cent; incomplete success in 30 per cent. Complete failures—None.

Stopford (Manchester) 1920:

271 operations—gunshot injuries.

Operations performed by various surgeons. Type of operation—end-to-end suture. Standard of recovery—neurological.

A. Upper Limb (median, ulnar, and musculospiral nerves).

Upper arm—Recovery of varying types in 88 per cent; failures (complete) in 12 per cent.

Forearm—Recovery in 76 per cent; failures in 24 per cent.

B. Lower Limb (sciatic, external, and internal popliteal nerves). Recovery in 85 per cent; failure in 15 per cent.

These figures are largely *interim* results.

Forrester-Brown (Edinburgh) 1920:

475 operations—gunshot injuries.

Operations performed by Sir Harold Stiles and the recorder. Standard of recovery—neurological.

A. End-to-end suture—158 operations.

(1) All cases.

Complete motor recovery 29 per cent.

Complete sensory recovery 19 per cent.

Complete trophic recovery 21 per cent.

Incomplete recovery of all functions 50 per cent.

(Total complete recovery seen in *five median nerve sutures and eight musculospiral nerve sutures*.)

(2) Comparison between different nerves.

Median nerve—50 per cent complete motor recovery; 28 per cent complete sensory recovery.

Ulnar nerve—17 per cent complete motor recovery; 13 per cent complete sensory recovery.

Musculospiral nerve—62 per cent complete motor recovery; 33 per cent complete sensory recovery.

B. Neurolysis—117 operations.

43 per cent full motor recovery; 10 per cent full sensory recovery.

These figures include both *interim* results and *true end-results*.

Platt (Manchester) 1921:

150 operations—gunshot injuries.

Type of operation—end-to-end suture. Standard of recovery—neurological.

Standard of failure—no appearance of conduction after one year or longer.

Musculospiral nerve—35 operations. Recovery in 26; failure in 9 (in 5 sutures of posterior interosseous nerve to main trunk).

Posterior interosseous—1 operation. Failure.

Ulnar nerve—47 operations. Recovery in 41; failure in 6.

Median nerve—30 operations. Recovery in 27; failure in 3 (all in forearm).

Brachial plexus (infraclavicular)—3 operations. Recovery in 2; failure in 1.

Sciatic nerve—25 operations. Recovery in 18; failure in 7.

External popliteal nerve—9 operations. Recovery in 4; failure in 5.

Interim results in the majority.

RESULTS OF END-TO-END SUTURE

The classical distinction between *primary* and *secondary* nerve suture is to some extent purely artificial, for it is often difficult to indicate the exact dividing line between the two procedures. The extreme perfection attained after many so-called primary sutures in the case of clean-cut divisions has long been appreciated, and it is usual to compare such results with the incomplete type of recovery which is the rule in the majority of the secondary sutures. The essential difference from a prognostic point of view, however, is not concerned with the exact chronology of the suture, but rather with the contrasted types of lesion and the conditions under which the repair is carried out. The end-to-end sutures in gunshot injuries belong almost exclusively to the secondary class. Under the conditions of emergency war surgery the opportunities for the practice of immediate nerve repair rarely arose; further, in the highly infected wound such attempts were with reason regarded as unjustifiable.

THE PERIOD OF DELAY BETWEEN THE ORIGINAL INJURY AND THE OPERATION (TIME FACTOR). It was pointed out many years ago by Bowlby that after a certain optimum period—arbitrarily estimated as two years—recovery tended to be less certain and less complete. The truth of these observations has been confirmed by most subsequent writers, and the importance of early repair of a nerve lesion has always been stressed. Our more recent experience tends to bear out this conception. It is, of course, impossible to state dogmatically the exact period of delay beyond which an operation is doomed to complete failure. For practical purposes a three-year limit is a useful working basis. Stopford's extensive clinical statistics on the results of nerve suture seem to show that the optimum period is longer in the case of operations in the proximal part of the limb. It was the considered opinion of the Medical Research Committee on Peripheral Nerve Injuries that, so far as is known, no period is so long as to preclude the possibility of recovery. The harmful effects of long delay depend on the development both of peripheral and central retrogressive changes. *The permanent degenerative changes which occur in the muscle bellies after prolonged denervation render these structures less capable of assuming function even though neurotization be established at a later date. But if they have been kept in the best possible condition as regards nutrition, by heat, massage, and electrical stimulation, the outlook is improved.* It has been shown experimentally that if union be prevented after division of a peripheral nerve-trunk, a not inconsiderable number of the cells of the anterior cornua and posterior root ganglia disappear completely. It is thus probable that with increasing periods of delay the regenerative process itself is less efficiently initiated and controlled by the spinal centres.

TOPOGRAPHICAL CONFUSION IN REGENERATION. Inaccuracies of regeneration due to the shunting of nerve-fibres along inappropriate channels must of necessity be present after every nerve suture. In a clean-cut division of a nerve followed by immediate repair, with the avoidance of torsion of either proximal or distal stumps, such errors are minimal, and give no clinical evidence of their presence. But in the more extensive lesions in which a generous trimming or resection is necessary, a considerable disturbance of the

intraneurial pattern results. The regeneration in such cases may be compared with the process of nerve-crossing in miniature. Such regenerative errors are undoubtedly represented in the imperfections of the neurological and functional results which characterize the greater proportion of the suture operations in the case of the more extensive gunshot lesions. The known superiority of the results of suture of the *musculospiral* nerve, as compared with the *median* and *ulnar* nerves, illustrates very clearly the part played by this factor. The chances of topographical confusion are especially great also in the case of suture of a nerve of small calibre to a larger trunk, e.g., the posterior interosseous to the *musculospiral*, or the anterior tibial or *musculocutaneous* to the external popliteal trunk—operations which appear always to be followed by more or less complete failure.

COMPARISON BETWEEN THE DIFFERENT NERVES

Musculospiral Nerve. All statistics show that this nerve heads the list of recoveries whether judged from a qualitative or quantitative standpoint. Almost perfect restoration of function has been described in a considerable number of cases, e.g., 20 out of 37 in the end-result series of Stopford. At the same time, a careful examination has shown that, in the majority of these highly successful results, the synergic action of the extensors of the wrist is lacking. It is probable, however, that this deficiency may be remedied by assiduous training after years of occupational use of the hand.

Ulnar Nerve. In this nerve the results have been physiologically imperfect, but not necessarily economically bad. Complete restoration of function in the ulnar intrinsic muscles of the hand appears to be unknown, whilst full sensory recovery is also a phenomenon of extreme rarity. The average sensory result involves the restoration of "protopathic" sensibility alone. There is less difference in the quality of the results obtained in the forearm sutures, as compared with the upper arm sutures, than was foreshadowed in some of the *interim* statistics. Many individuals with complete lesions of the ulnar nerve have been known to be capable of engaging in laborious occupations such as dock-labouring, coal-mining, and so forth. But the musician, the artist, and the fine manual worker are seriously handicapped by the incomplete recovery of the muscles of the hypothenar eminence, the interossei, and the adductors of the thumb.

Median Nerve. The results in the case of this nerve have been uniformly disappointing, chiefly owing to the extreme functional disablement consequent on the inadequate recovery of sensibility. This nerve illustrates very beautifully how co-ordination in finer movements is dependent on the complete restoration of the paths for all types of afferent stimuli. A reference to the details of sensory recovery in Stopford's series shows that at the very best there has been little more than the reappearance of full protopathic function, whilst in 16 per cent of the operations no sensory recovery was seen. In more than half in the same series there has been no neurotization of the thenar muscles. The latter disability, however, is usually overshadowed by the effects of the sensory loss, which is manifested most dramatically by the helpless index finger. There is also another type of relative failure seen sometimes after suture of the median nerve, viz., the recurrence and persistence of inveterate pain and hyperaesthesia.

Sciatic Nerve. Here the neurological and economic results have been consistently poor. No case is on record where recovery has been demonstrated in the intrinsic muscles of the foot. The type of sensory restoration has been on the average exceedingly defective, and this has constituted in many patients a source of danger from the tendency to the development of traumatic ulceration in the foot. The earlier and more complete recovery seen in the calf muscles, as compared with the anterior tibial group, has often been instrumental in determining the production of a contracture in patients who have

lacked post-operative supervision. As in the case of the median nerve, irritative phenomena are occasionally seen, and add to the serious psychical and physical disablement of the individual.

External Popliteal Nerve. The percentage of complete failures has been high in the case of this nerve; but, on the other hand, very complete types of recovery have been described. In uncomplicated lesions the economic capacity of the individual provided with an efficient walking apparatus is very satisfactory.

Of the results of suture of the less commonly injured nerves the information is too scanty to merit a detailed discussion.

RESULTS OF NEUROLYSIS (FREEING OR LIBERATION OF THE NERVE). It is difficult in many cases to define how far the operations of this class have brought about the recovery which has been seen to follow their application. In many nerve injuries belonging to the category of pure compression lesions, the surgical removal of the compressing agent is rapidly followed by the reappearance of both conductivity and function. This means that the loss of conduction has not been associated with actual degeneration of the axis cylinders. The effect of a neurolysis under these conditions is to restore the mobility of the nerve-trunk in the injured area by eradicating a factor which is the direct cause of a cumulative intraneurial trauma dependent on the repeated stretching and friction of the anchored nerve during the natural movements of the part. Where a compression lesion has been in existence for some considerable time, the restoration of conduction now depends on the occurrence of regeneration alone, and the obstacles to the full attainment of such spontaneous repair are situated in the interior of the nerve-trunk, i.e., the interstitial fibrosis of a traumatic neuritis. *Thus, after the elimination of the cause of the trauma at a late stage, there is no certainty of achieving a complete restoration of function.*

BRIDGE OPERATIONS. This term is applied to the various methods of filling in an extensive gap in the continuity of a nerve-trunk. Such operations have been practised for many years, and, as a result of much clinical and experimental research, the question of their value has been more or less finally settled. The following methods have been in vogue in the past, and were probably tried by most surgeons during the war period (1914-1918).

a. Neuroplasty, i.e. the bridging of a gap by the turning down of a flap from the proximal to the distal nerve stump, or vice versa. This type of operation may be dismissed at once as having been proved both illogical and futile.

b. Tubulization, in which some form of conducting channel is inserted, such as a tube constructed of fascia, blood-vessels, or some foreign material. These operations have also failed to establish themselves as procedures of any value in peripheral nerve surgery.

c. Nerve-grafts. Many of the earlier reported successes in nerve-grafting do not bear scrutiny in the light of modern experience of the many pitfalls which accompany the interpretation of the clinical signs of recovery. It is generally agreed that down-growing axis cylinders may cross a short gap, utilizing the channels afforded by a graft, whether this be of an autogenous, homogenous, or heterogenous nature. Where a gap is filled in by a graft equal in size to the injured nerve or by multiple small grafts arranged in cable fashion, a sufficient number of axons may in theory be conveyed into the distal nerve-trunk, and thus ensure adequate function. Autogenous cable-grafts, and large homogenous single-trunk grafts, have been used extensively in recent years by the American and French surgeons, but have rarely been employed in this country. A considerable literature has now accumulated dealing with the general failure of such operations. It is fair to state, however, that evidences of regeneration may be seen when a

short gap is bridged by a large graft or number of grafts which reproduce the full calibre of the injured nerve-trunk.

The writers have had the opportunity of examining a considerable number of patients who have been subjected to nerve-grafting operations, including those examined and reported on by the Medical Research Council and referred to in the Addendum of the Report published by that body. The majority of these operations were complete failures; but in a few, evidence of partial recovery was established. In one patient a gap of $3\frac{1}{2}$ in. in the ulnar nerve in the arm had been filled in by a portion of the internal cutaneous removed from the same limb. Three years and three months later there was recovery of voluntary power and faradie excitability in the flexor carpi ulnaris, flexor profundus digitorum, and the abductor minimi digiti. There was little recovery of sensation, as complete anaesthesia to light touch persisted, whilst appreciation of pinprick over the little finger was imperfect. A second patient who showed evidence of some recovery was a man with a musculospiral injury which had been grafted with alcoholized human nerve. Two years and four months from the date of the operation there was recovery of voluntary power in the supinator longus and the wrist extensors. There was no recovery in the thumb extensors, nor could the fingers be voluntarily extended. These two patients represented the best results of nerve-grafting we have seen.

In irreparable injuries of certain nerves, where no alternative operation for the restoration of function is available, a graft operation may thus be legitimately practised. But the cases calling for this treatment are few, and become still fewer with increasing experience. *The surgeon must not lessen in any way his efforts to obtain end-to-end suture, even by a two-stage operation, no matter how exhausting and tedious the procedure.*

The attitude of British surgeons towards the value of nerve-grafts continues to be one of scepticism.

RESULTS OF OPERATIONS DESIGNED TO RESTORE FUNCTION IN IRREPARABLE LESIONS OR IN CASES OF INCOMPLETE RECOVERY

The problems afforded by the irreparable nerve lesions, and the cases of incomplete recovery after nerve suture, differ in degree but not in type. The operations applicable under such circumstances consist in: (1) Attempts to restore motor function or to achieve a reasonable degree of compensation; and (2) As a last resort the elimination of a useless, dangerous, or painful limb. Similar restorative procedures have long been practised for the residual paralyses of anterior poliomyelitis. In the case of incomplete recovery after suture, it is important, from an economic standpoint, to decide whether the condition is to be regarded as final and all treatment discontinued, or whether it is worth while performing some alternative operation. Months and years may be wasted in a vain attempt to improve function by massage, electricity, and allied physical treatment in patients in whom recovery has reached its final stage. Many patients who have had a divided *sciatic nerve*, and in whom little or no recovery of nerve conduction has been regained, particularly on the sensory side, have a better industrial outlook when the limb is amputated. A great number of such amputations have been performed, and many are still to be performed, with definite benefit to the war-pensioner. The thin, wasted, atrophic foot, particularly liable to pressure sores—often incorrectly called trophic ulcers—is an encumbrance, and in such cases a below-knee amputation and a well-fitting artificial limb materially lessen the final disability.

Amputation is sometimes called for to remove the stiff, contracted fingers following incomplete recovery in a lesion of the *ulnar nerve*, for in these cases the operation of arthroplasty on the interphalangeal joints has been disappointing in its results.

Failures or partial failures after operations on the *musculospiral nerve* have been very successfully treated by tendon transplantation. The exact technique and details of this procedure will vary, but in the main the operation which has been most efficient is as follows—(it was originally devised by Sir Robert Jones):

Transplantation of the

- Pronator radii teres into the extensor carpi radiales longior and brevior,
- Flexor carpi ulnaris into the extensor communis digitorum and extensor longus pollicis.
- Flexor carpi radialis into the extensor ossis metacarpi pollicis and extensor brevis pollicis.

The results of this operative procedure are striking—a useful and strong hand is obtained, a hand capable of being utilized for most ordinary occupations.

Other tendon transplantsations are occasionally of service to assist function, e.g., after lesions of the *median nerve* to restore some power in opposing the thumb; but these are not commonly practised.

Where there is no recovery after lesions of the *external popliteal nerve*, attempts have been made to remedy the resulting foot-drop by tenodesis, i.e., the converting of the paralysed dorsiflexors of the foot into ligaments by attaching them to the tibia. These newly formed ligaments tend to stretch, and for this reason the operation is not often employed. It has been found that a light side-iron, with a toe-elevating spring attached, yields a better functional result in the majority of patients.

The residual disability following a fairly successful nerve suture is often capable of improvement by simple operative means if the patient is carefully examined and his exact disablement analysed. As examples may be quoted the short tendon Achillis, or fixed flexion deformity of the interphalangeal joint of the great toe following a sciatic injury. Such disabilities are not infrequently overlooked.

TABLE SHOWING THE PERCENTAGE OF COMPLETE SUCCESSES OR MARKED IMPROVEMENT (GOSSET)

Nerve	Neurolysis, per cent	Suture, per cent
Musculospiral.....	95	45 to 55
Median.....	47	44
Ulnar.....	43	17
Sciatic—trunk, 1917.....	55	35
Sciatic—trunk, 1920.....	..	40
Sciatic—external popliteal.....	66	50
Sciatic—internal popliteal.....	..	40 to 50

ISCHEMIC PARALYSIS AND PERIPHERAL NERVE WOUNDS

Cases of ischemic paralysis are sometimes confused with those of peripheral nerve injuries. This type of paralysis may follow ligation of the axillary, brachial or possibly the subclavian artery, or more

commonly the too close application of a plaster of Paris cast. Such paralyses are treated in detail by Tinel and others.*

METHODS OF DETERMINING THE EXTENT OF PERIPHERAL NERVE INJURIES

The best way to determine definitely whether a nerve is functioning before operation is through the application of a faradic current below the supposed nerve lesion over the muscles supplied by that nerve. Besides being able to use a faradic coil, one must possess anatomical knowledge of nerves in order to test not only muscular reactions but also sensory involvements and different trophic changes, particularly when examining an old case. I am not covering all these points: first, because I am attempting only to advise surgically; second, all these points are repeatedly covered by excellent books. If a physician is not schooled in this method of examination, the services of a trained neurologist should be obtained.

By applying the current one should be able to discover whether a nerve is completely or only partially functioning. The result of this examination will, of course, help in determining the conduct of both surgical and non-surgical treatment.

A faradic coil, such as Bristow's, should be used upon surgical exposure of a nerve, while operating (the galvanic current does not demonstrate reactions of degeneration). The negative pole should be placed on the patient's neck in cases of injury of the upper extremity, or on the small of the back in cases of injury of the lower extremity. The positive pole should be properly sterilized, and upon exposure of the nerve the current should be applied to the nerve *above* the site of the lesion. An instrument can be devised having both poles exposed at the same time, and this applied to a nerve above the seat of operation will give the necessary reading. It is thus possible to determine whether any of the axis cylinder is conducting through the scar substance. Another method consists in combining the two poles and applying them at the point of contact (Fig. 562). The current should never be applied *below* the

* Tinel, J. T. *Nerve Wounds*. N. Y., Wood, 1917.

Benisty, A. *The Clinical Forms of Nerve Lesions*. Univ. London Press, 1918.

Stookey, B. *The Treatment and Repair of Nerve Lesions*. Saunders, Phila., 1918.

Jones, Sir Robert. *Notes on Military Orthopedics*. Hoeber, N. Y., 1918.

site of the lesion, as such a procedure causes confusion by demonstrating a reaction which leads the examiner to assume that there is an impulse through the injured area.



FIG. 562. Electrode for direct stimulation of surgically exposed nerve with faradic current.

In a new injury where tissues are exposed, if a faradic coil is not obtainable and there apparently is no solution of continuity, the blunt edge of an instrument may be flicked transversely across the nerve. A convulsion of the musculature supplied by the nerve, below the site of injury, helps eliminate the possibility of nerve severance. Such a method, which is not scientific, of course, determines only the question of nerve severance, and not always the extent of damage to the nerve.

THE SURGICAL TREATMENT OF PERIPHERAL NERVE INJURIES

Any surgeon who is not thoroughly familiar with the anatomy of the peripheral nerves should avoid absolutely the handling of peripheral nerve injuries, or else he should study the subject carefully before attempting any surgical procedure. A careful pre-operative examination should be made, preferably by a neurologist, unless the surgeon has made a special effort to familiarize himself with the methods of performing neurological tests. A long period of treatment and an unsatisfactory outcome all too frequently follow examination and treatment by an inexperienced physician.

End-to-End Anastomosis the Only Satisfactory Surgical Procedure

Up to the present time the only entirely successful method of peripheral nerve surgery is that of end-to-end anastomosis. Attempts to transplant sensory nerves, such as the long saphenous or the musculocutaneous, have proved unsuccessful. In cases in which,

for some reason, an end-to-end anastomosis cannot be ordinarily effected, stretching, transplantation of the nerve with approximation, or some method of stretching and transplantation with flexion accommodation of the immediate joints should be done.

Early Examination and Treatment in Surgical Cases

The sooner an injured nerve is sutured the better are the prospects for recovery, not only in respect to early regeneration of the nerve, but also in respect to prevention of degeneration of the muscular tissues, supplied distally by the injured nerve. The exposure of the nerves at the immediate time of accident for the purpose of examination causes no additional injury if the examiner proceeds carefully and intelligently by handling the nerves as gently as possible. If, following an injury, the physician fails to make a careful examination and so permits an injured nerve to go untreated, or if his suture technique is poor, certain degenerative changes take place, resulting in an ascending and descending hyperplasia of connective tissue within the sheath. The pathological tissue must then later be excised proximally and distally until contact with the normal axis cylinder is obtained. In some of these cases, even after a stretching of the distal and proximal end of the nerve, an end-to-end anastomosis proves impossible, and other less satisfactory methods must be adopted. (These methods are shown in Figures 570-573, 578 and 579.) The employment of these measures seriously interferes with or prolongs the patient's chances for ultimate complete recovery.

Technique of Peripheral Nerve Surgery

A primary point for every surgeon who operates on an injured nerve to remember is that he should perform all steps by *sharp dissection*, blunt dissection being always entirely avoided. Bruising and trauma should be avoided as much as possible, as all available uninjured tissue may be needed to effect approximation. The use of blunt forceps to hold the new sheath makes the operation a little more difficult and tedious, but lessens the possibility of operative injury.

The method of approach to an injured nerve never varies, whether the injury be recent or of long standing. Incisions of at

least 3 or 5 in. in length are first made above and below the site of the injury. The normal nerve above and below the injured area is exposed, without disturbing the sheath of the nerve. A blunt hook is then passed around the nerve both above and below the injured or pathological area, which holds it without injury. Folded soft probes or long buttonhooks, properly nickeled, can be used.

This method of exposure has two advantages. First, it permits the surgeon to begin his operation by the exposure of normal healthy tissue, a much easier course, particularly in cases of long-standing injury, than if he immediately exposes injured or pathological tissue. Second, it permits the operator to dissect down and up the normal sheath to the point of injury, thus giving him an opportunity to differentiate between normal and injured tissue and to decide the amount of tissue to be removed. If a surgeon first cuts down directly upon the injured region of a nerve he experiences great difficulty, because of pathological changes, in deciding what tissue should be removed; and he may cut structures which should be left undisturbed if the result is to be successful.

CASES OF RECENT INJURY. In these cases macroscopical inspection of all exposed nerve cables usually shows that the only operative procedure necessary is simple suture of the sheath. This suture must *always* be so done as to avoid *any tension* on the neural sheath. No suture material should be introduced into the nerve substance, except that which may be necessary for the closure of the sheath. It is difficult to close the sheath without coming in contact to a slight degree with nerve substance.

A careful and complete closure of the sheath should be made in every case and interrupted sutures must be used in the sheath. If these two points are not followed and a gap is left in the sheath, there may develop a wild growth of nerve through this opening, which may extend into the surrounding tissues and bring about a painful neuroma or causalgia. Such a complication means another operation and an indefinitely prolonged disability period.

For closure of the sheath, No. 00 catgut (Fig. 563) of pyoktanin is preferable. A very small, fine, curved needle with a non-cutting edge should be used. The use of silk, as advocated by some surgeons, often adds to the danger of subsequent cicatrization or hyperplasia

which interferes with the process of regeneration. This latter suggestion (the use of catgut instead of silk) may meet with disapproval on the part of some. They, however, are the men who are highly

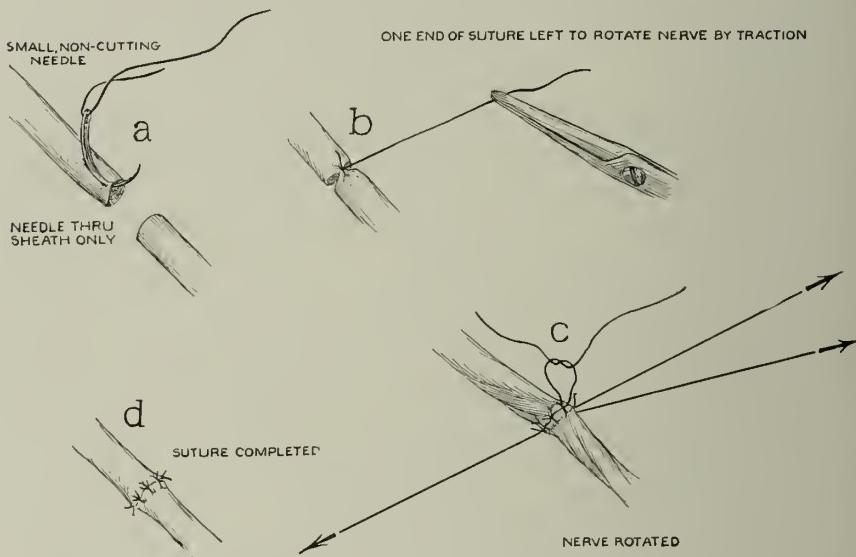


FIG. 563. Technique of nerve suture using No. 00 catgut only.

trained in the use of silk sutures. For the surgeon not intensively trained, I suggest the use of No. 00 catgut.

After the first suture is introduced into the nerve sheath and tied, the needle end can be cut, but the other end should be allowed to remain free. Other sutures should then be introduced, using the free portion of the catgut to hold the nerve and rotate it at the same time, thus avoiding as much as possible bruising of the tissues (Fig. 563).

When the nerve is put back into its original bed no protective materials, such as fat, fascia or muscle wrapped around it, are necessary. A careful dissection of the nerve bed, which removes all tags of tissue and makes the bed as smooth as possible before the sutured nerve is dropped back into it, is all that is needed.

CASES OF LONG-STANDING INJURY. In these cases, when a large, bulbous, tumorlike mass has formed at the point of injury, there has occurred a partial or complete severance of the nerve, with a bridging of the gap with the pathological tissue. The longer the period follow-

ing injury, the greater will be the amount of pathological tissue. Definite destructive changes will have occurred in the axis cylinder, the microscopical finding being that of an ascending and descending interstitial fibrosis. Faradism will serve to indicate the degree of reaction of degeneration (Fig. 562). Be sure to apply the current to the nerve *above* the seat of pathology.

In such cases careful exposure of the healthy nerve above and below the seat of the lesion, before dissecting the injured area, is especially important for contrast. The tumor mass is held by blunt forceps and an incision is made transversely through the center, to about two-thirds of its depth. At this depth the tissue looks like any hard cicatricial tissue. While holding the tissue at the point of this incision, similar incisions are made, as close to each other as possible, above and below the first one, until the normal cables are exposed (a razor blade is good for this).

The surgeon must note carefully, during this entire procedure, whether the normal nerve ends can be brought together without tension. In order to ascertain this, no harm is done by taking hold of the normal nerve above and below the point of injury, with gauze, and using gentle traction. This stretches the nerve and so permits considerable normal substance to be obtained. In cases of long-standing injury the proximal end is likely to retract more than the distal end. In a case of sciatic lesion of several months' standing, I have been able to bridge a 5 inch gap by stretching the nerve in this fashion and flexing the adjacent joints.

In some instances it may be advisable to suture with some of the cicatricial tissue still in the field rather than to discover too late that, although by the removal of all this tissue normal cable ends have been exposed, approximation cannot be effected even by nerve stretching, nerve transplantation and flexion of the joints. Figures 578 and 584 show how some problems encountered during operation on cases of long-standing nerve injury can be solved. It is very desirable, while making transverse incisions of pathological tissue, to have one assistant in a position to flex adjacent joints in order to be sure of approximating normal tissue when ready.

In cases in which, even with stretching, flexion accommodation or transplantation, the nerve cannot be approximated a two-step operation is indicated. In the first step the method already described

is followed, closing the tissues with a gap in the nerve and subsequent stretching by bringing the joints into normal position. In sixty to ninety days a second operation may be performed, with suture of the nerve.

NON-SURGICAL TREATMENT OF PERIPHERAL NERVE INJURIES

The non-surgical treatment of peripheral nerve injuries is discussed in detail in the individual sections devoted to injuries of these nerves.

BRACHIAL PLEXUS INJURIES

Injuries to the brachial plexus may be caused by a sudden outward and downward push of the shoulder, a blow from above, torsion of the neck against the shoulder, or by a fall in which the shoulder comes in contact with some hard object. Such accidents are apt to produce a stretching of the nerves of the entire plexus, resulting in a general paralysis of the arm. Sometimes the injury is severe enough to tear one or more of the nerve roots at their cervical segments. Dislocation of the shoulder, particularly subcoracoid, can cause a brachial plexus injury.

SYMPTOMS. These patients complain of complete numbness of the entire arm, which began almost immediately following the injury. This numbness is accompanied by a drooping of the shoulder and total inability to move the arm. There is a definite reaction of degeneration to faradism, usually over the entire group of muscles.

TREATMENT. The treatment of these cases is always time-consuming. The arm should be placed in a sling with the forearm at right angles. The sling should support the hand because, with paralysis of both flexors and extensors, if the wrist and hand are unsupported and drooping, edema and joint fibrosis occur. Joint fibrosis must be especially guarded against in these cases; it may be caused by prolonged disuse of the arm and by trophic change as well as by lack of proper support of the wrist and hand.

In applying the sling the entire arm should be carefully drawn up in order to take the tension away from the shoulder. In cases of deltoid paralysis in which the arm is not properly supported, the



FIG. 564. Complete brachial paralysis. Note edema of forearm and atrophy about shoulder.



FIG. 565.

FIG. 566.

Figs. 565 and 566. Same case as Figure 564. Palmar view shows pronounced atrophy of thenar and hyperthenar area. Dorsal view shows ape-like appearance of hand and curving of nails.

head of the humerus, because of the relaxed deltoid and capsule, is pulled down toward the lower end of the glenoid cavity and is likely to dislocate. Further stretching of the brachial plexus may also follow insufficient support of the entire arm. I have found it advantageous in these cases to use the Littler-Jones abduction splint to take the pull off the shoulder, to allow the patient to massage and move elbow, wrist, and fingers, and also to prevent edema of the extremity, which always occurs if it is carried down at the side.

Massage is an important therapeutic aid. It should be given every day, by someone in the patient's family if possible, since its application by a professional is expensive. In conjunction with massage, sinusoidal galvanism should be administered over the entire musculature at least every other day. The current applied should be sufficient to stimulate the muscle fiber, thereby preventing as far as possible interstitial muscular changes, and atrophy.

Surgical Interference. This should not be considered until non-operative treatment has been tried for at least nine months to a year. One must be guarded in this statement, however, because if one is possessed of knowledge indicating a terrific injury with probable tearing of the plexus then one is justified in immediate exploratory investigation. Or when injury is due to a foreign body the same judgment should be exercised. It demands a great deal of judgment and experience to know when and when not to operate on these cases; hence the advice of an experienced neurologist, particularly one who has undergone extensive war work, is advisable. One of my own cases with complete brachial paralysis resulting from a severe wrenching recovered entirely without surgical interference, in two and one-half years. If an operation is resorted to, it should be performed only after careful examination by a neurologist, and should be performed by a surgeon experienced in this type of work. Since such an operation, because of anatomical considerations and the variable types of neural involvement, lies entirely without the field of the general surgeon, the details are not discussed in this volume.

PROGNOSIS. If recovery occurs without surgical interference a disability period of *at least three years* must be anticipated. The patient is totally disabled for the first nine months to a year. At least six months elapse before signs of recovery of any kind become apparent. As a rule sensory improvement is first noticeable. The

return of sensation occurs progressively down the arm and is generally manifested first in the tissues supplied by the circumflex and musculocutaneous nerves, but sometimes in those supplied by the musculospiral or radial nerves. In this type seldom if ever does a complete recovery take place, and where there are signs of recovery, the disability runs from two to three years. Be careful to prognose some permanent involvement of one or more of the plexus branches. At the end of two years the patient may be able to do certain types of manual labor but he will not have recovered completely. I have only 1 case on record in which recovery was complete at the end of two years. In almost every case, the muscular and joint changes are so pronounced that, even though nerve regeneration is apparently complete, a noticeable loss of function persists indefinitely.

The prognosis after surgical treatment is the same, although it may be longer and more guarded where actual suture has been performed some months after injury.

CIRCUMFLEX NERVE INJURIES

Injuries of the circumflex nerve alone are usually the result of dislocation of the shoulder. Sometimes they result from fractures of the anatomical or surgical neck of the humerus, or they may be caused by direct violence to the nerve.

SYMPTOMS. The patient experiences immediate inability to abduct or raise the arm over the head or even to raise it to the level of the shoulder, because this type of injury causes paralysis of the deltoid and teres minor muscles and capsule of the shoulder joint. Pain is almost always absent. Some sensory skin changes occur over the circumflex supply. As atrophy of the deltoid progresses, a noticeable change takes place at the acromion process of the scapula: a marked depression between the acromioclavicular junction and the head of the humerus, with inability fully to abduct the shoulder. This depression is accentuated by the downward drooping of the head of the humerus, due to relaxed musculature. Faradism shows a varying reaction of degeneration in the affected muscles, usually complete at first.

TREATMENT. The arm is carried in a sling, and is drawn up as high as possible against the side of the body, in order that all "pull" be taken from the deltoid and teres minor muscles. The

Littler-Jones splint can be used to advantage here. The splint can be worn for three or four weeks, then carried in a sling three or four weeks, then alternated; in this way preventing to some extent

FIG. 567.

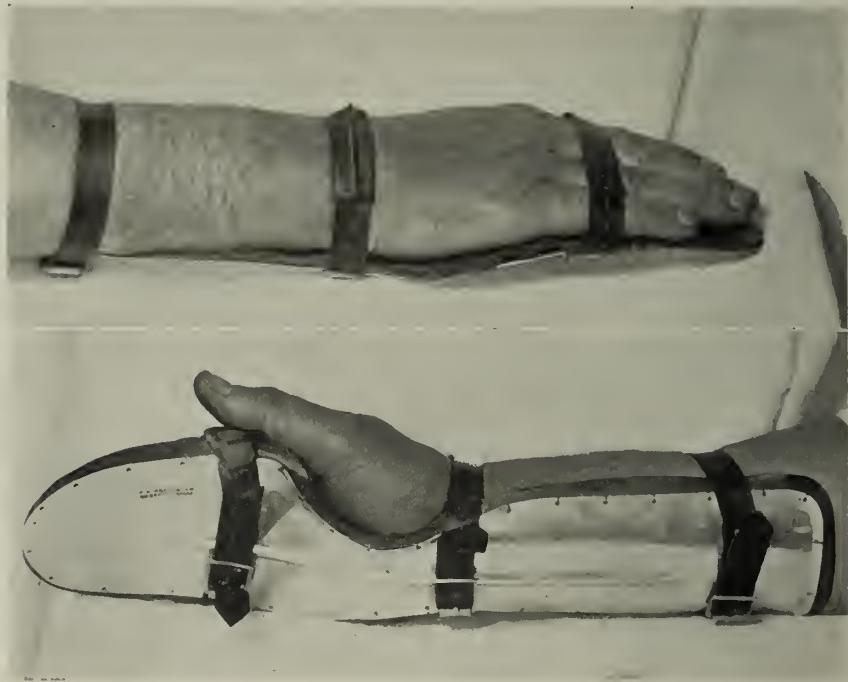


FIG. 568.

Figs. 567 and 568. Simple cock-up splint to prevent wrist-drop. This type of cock-up splint is useful in cases of young people but likely to produce fibrosis of joints in older people.

a fibrosis of the shoulder. Sinusoidal galvanism should be administered at least every other day in order to stimulate the muscles. Two or three times each week, where the Littler-Jones splint is not used, the arm should be taken out of the sling and the shoulder joint moved in various directions in order to overcome the possibility of fibrosis. Massage, administered at least every other day, is also a useful therapeutic aid.

Surgical measures on this nerve in my experience have not proved successful. I have seen 3 cases in which operative measures were resorted to, and regeneration failed to take place in any of

them. If surgical measures were employed, the patient would have to be placed prone on the table, the surgeon approaching the nerve through an incision in the back.



FIG. 569. Better type of cock-up splint, leaving fingers free.

PROGNOSIS. Regeneration is very slow, requiring one to two years, and in some cases is incomplete, owing to a permanent atrophy of the deltoid muscle or lack of nerve regeneration. Sometimes fibrosis of the shoulder joint complicates the prognosis. Many patients, however, show compensatory development in the trapezius, supraspinatus and pectoralis major and minor muscles, etc. and eventually enjoy nearly normal compensatory shoulder action. In spite of this possibility of compensatory muscular development the physician must be very guarded in estimating the disability period and the degree of final reestablishment of function.

MUSCULOCUTANEOUS NERVE INJURIES

SYMPTOMS. This nerve is seldom injured alone between the shoulder and elbow except by direct trauma but is affected along with the musculospiral or median and ulnar nerves. Injury to this nerve occasionally occurs close to the spot at which the nerve passes through the coracobrachialis muscle.

Since the musculocutaneous nerve has no motor supply below the elbow and supplies only three muscles in the upper arm (the coracobrachialis, the brachialis anticus and the biceps), a simple objective test for injury is to have the patient attempt to flex the

forearm on the arm. In making this test, the forearm should not be held in mid-supination, as such a position calls into action the supinator longus and brachioradialis muscles which are supplied by the musculospiral nerve. Hence the forearm should be fully supinated in order to eliminate as far as possible the action of these muscles, also to test out the sensory distribution of this nerve in its course below the elbow. Faradic tests will complete the findings.

TREATMENT. When surgical repair is done, this nerve can best be approached by drawing the biceps outwards. The nerve will then be found to lie anterior and external to the median nerve as it comes out of the coracobrachialis muscle, a little above the level of the insertion of the deltoid. In obtaining a suture of the nerve, a simple flexing of the forearm assists materially in accomplishing the suture. Flexion should be maintained for thirty days, after which the arm may be gradually lowered one-half to one inch at a time, until it is in a position of full extension. Sinusoidal galvanism may then be applied to the muscles two to three times a week. After full extension following suture has been obtained, galvanic treatment can be continued indefinitely until such a time as voluntary control and strength, in the judgment of the attending surgeon, have returned.

When there has been no external wound it is advisable to treat such a case conservatively, first keeping the arm in right-angle flexion, and applying galvanism directly to the muscles two to three times a week for the first six to nine months. Then if there is no sign of regeneration surgical interference can be resorted to. Here one is justified, particularly when not trained in peripheral diagnosis, in calling in a neurologist to assist in attempting to find the lines of the lesion.

PROGNOSIS. Since this nerve is usually affected in conjunction with other nerves, prognosis must be guarded as to ultimate complete recovery. Nine months to a year usually elapse before signs of recovery become evident, and two to three years pass before full recovery has taken place. Even then it may not be complete.

INJURIES OF THE MUSCULOSPIRAL NERVE

SYMPTOMS. Injury to the musculospiral nerve, the most common and yet most successfully treated of all neural lesions of the upper

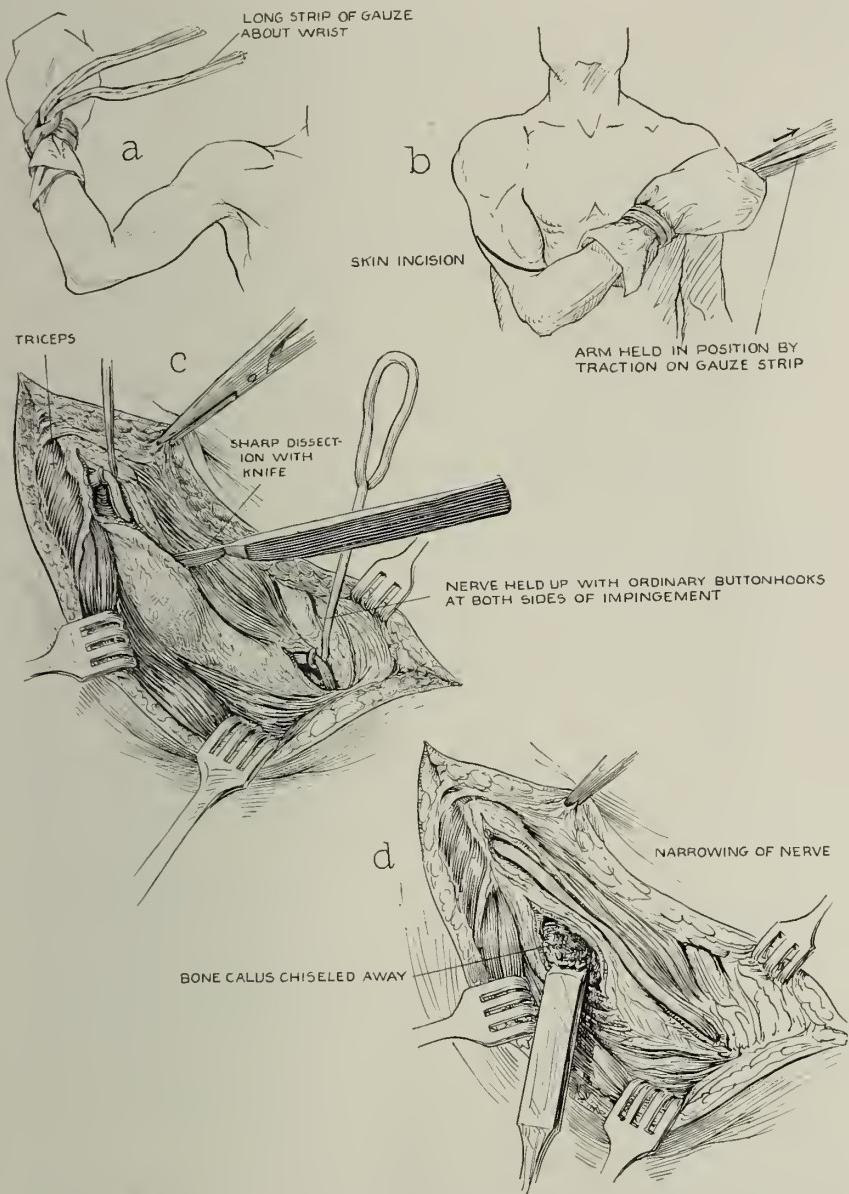


FIG. 570. Method of transplanting musculospiral nerve incorporated in callus following fracture of humerus. Drawn at time of actual operation by author showing how arm can be held by gauze traction.

extremity, may accompany fractures of the humerus, particularly in the middle and lower third, because of the close anatomical relation of these two structures. The musculospiral nerve supplies

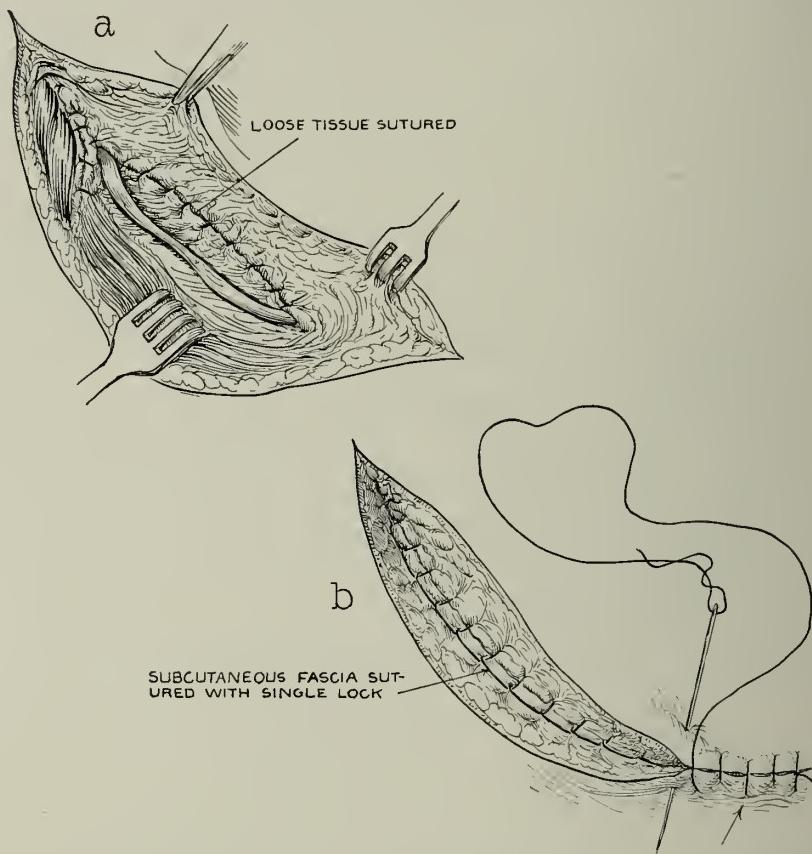


FIG. 571. Same operation as Figure 570, showing transplantation of nerve outside of triceps and biceps fascia over nerve.

the triceps muscle between the shoulder and elbow, coming from the plexus formation between the internal and external heads of the triceps in the axilla. It passes outward and around the outer side of the humerus through the intermuscular septum, approximately 10 cm. above the outer condyle of the humerus, and at this point it lies practically upon the humerus, in the musculospiral groove.

If the lesion is near the shoulder, with the entire arm resting on a table sidewise the patient is unable to extend the forearm on the arm. This symptom, considered with the results of faradic

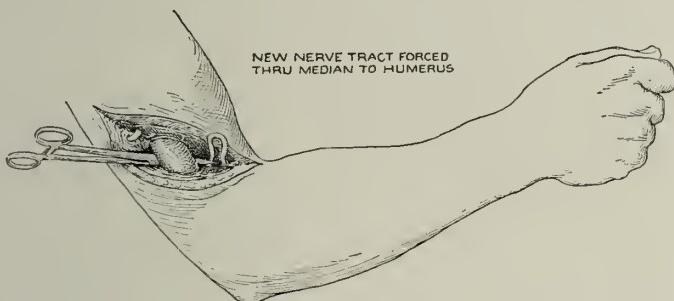


FIG. 572. Short musculospiral nerve being carried on inner side of humerus, elbow flexed.

tests, suffices to make the diagnosis clear. Of course in lesions high up, besides demonstrating an inability to extend the forearm on the arm, there will also be lower-arm symptoms such as loss of supination of the forearm together with wrist-drop, and some sensory loss along the radial side to the dorsum of the hand between the thumb and first finger. Injury to this nerve is never painful; at least in the many cases I have examined and treated I have never seen a causalgia. If the lesion is near the elbow, the patient can fully extend the forearm on the arm but with the arm in mid-supination, which is the proper position at rest, he has no control over the supinator longus muscle or the brachioradialis; so that supination and flexion of the forearm are weak. Wrist-drop is another symptom of lesions of this nerve in the vicinity of the elbow. In affections of the musculospiral nerve one can wait six or eight months without danger before operating because, first, this nerve, if it is going to regenerate without operation, will show some signs in six to eight months; second, the muscular changes are not great nor permanent.

While waiting the patient should wear a cock-up splint on the wrist, the arm being carried at right angles and sinusoidal galvanism applied at least twice a week to the muscles affected. There is some difference of opinion (as described later) regarding the use of the cock-up splint in musculospiral lesions, some neurologists claiming that it assists in producing a joint fibrosis. However, there are many

cases in which fibrosis occurs when a cock-up splint has not been used; we had many such cases at the Alder Hey Military Hospital, Liverpool, during the War. The cock-up splint is advantageous in such cases as it maintains the selective position for working purposes, i.e., slight extension beyond the horizontal line or the long axis of the forearm.

TREATMENT. If surgical treatment is necessary, operation may be performed on this nerve as far down as the point at which it makes its exit from the supinator brevis muscle. Below this point it becomes small and difficult to suture; in which event a compensatory tendon transplantation is therefore necessary.

The operative position of the patient varies with the location of the injury. In a case in which the operation is to be performed in the vicinity of the brachial plexus or axilla the patient should lie on his back; if it is to be performed between the anterior and external head of the triceps, he should lie on his abdomen. If operation is to be performed in the vicinity of the musculospiral groove he should lie on his back, with a soft roller bandage attached to the wrist, so that a nurse may hold the arm across the chest (Fig. 570).

If the lesion is near, or involves, the groove, the nerve should be transplanted by suturing a portion of the triceps muscle beneath the point of nerve approximation or transplantation. In performing this suture, no ill effects result from placing the nerve external to the aponeurosis of the muscle, under the deep fascial layer.

Flexion of the elbow, together with the stretching, will accommodate up to about 2 inches' shortening of the nerve, where pathology calls for resection of a certain amount of nerve tissue. In cases of severe shortening, the humerus must be resected and shortened, and the forearm flexed before the nerve ends can be sutured. This is a radical procedure, however. Some surgeons have suggested that in cases of severe shortening the proximal end of the nerve be carried around the inner side of the humerus and then sutured, as shown in Figure 572. This method is not an efficient one because it calls for too much surgical technique for the average surgeon.

Since suture should always be accomplished without causing the *slightest tension on the nerve*, in cases calling for flexion of the arm, the arm should be held in that position for forty-five days after operation, to make sure there is no strain on the injured nerve. The arm

may then be let down about half an inch each day, until full extension is obtained. Sinusoidal galvanism should then be applied to the muscles.

PROGNOSIS. The outlook for ultimate complete recovery is excellent in injuries involving the musculospiral nerve. The first signs of regeneration, as a rule, appear within six to seven months. As in the regeneration of all the peripheral nerves, sensation first makes its appearance, then voluntary muscular control and finally signs of reaction to faradism. A year to sixteen months elapse before recovery is complete (conservative estimate). The longer the operation is delayed, however, the longer the term of disability should be. I am a firm believer in the wearing of a cock-up splint before and after operation on the nerve, to control wrist-drop. It should be worn for a month or two even after signs of motor control present themselves. Some neurologists claim it is not necessary and that the wearing of the splint tends toward a joint fibrosis. I have seen this condition develop where no splint was worn. Every other day the splint can be removed and wrist and fingers massaged.

INJURIES OF THE MEDIAN NERVE

Injuries of the median nerve between the shoulder and elbow seldom occur uncombined with injury to the ulnar and musculocutaneous nerves. The median nerve below the elbow is more easily injured than any other peripheral nerve, either direct trauma or indirect trauma (injury following a fracture) affecting it. Causalgia of this nerve is of more frequent occurrence than causalgia of any other nerve except the internal popliteal. Exceptions occur in any given case. I operated on one boy with a distinct causalgia who had suffered a fracture of the humerus at the middle and lower third, and I found a band of constricting adhesions about the median nerve.

SYMPTOMS. As in cases of injury of every other peripheral nerve, the physician must have a good anatomical and physiological knowledge of the median nerve, if he is to draw correct conclusions from the symptomatology and carry out an effective course of treatment. The following brief statement of the action of the median nerve may prove helpful to physicians who must quickly study the subject before handling an emergency case.

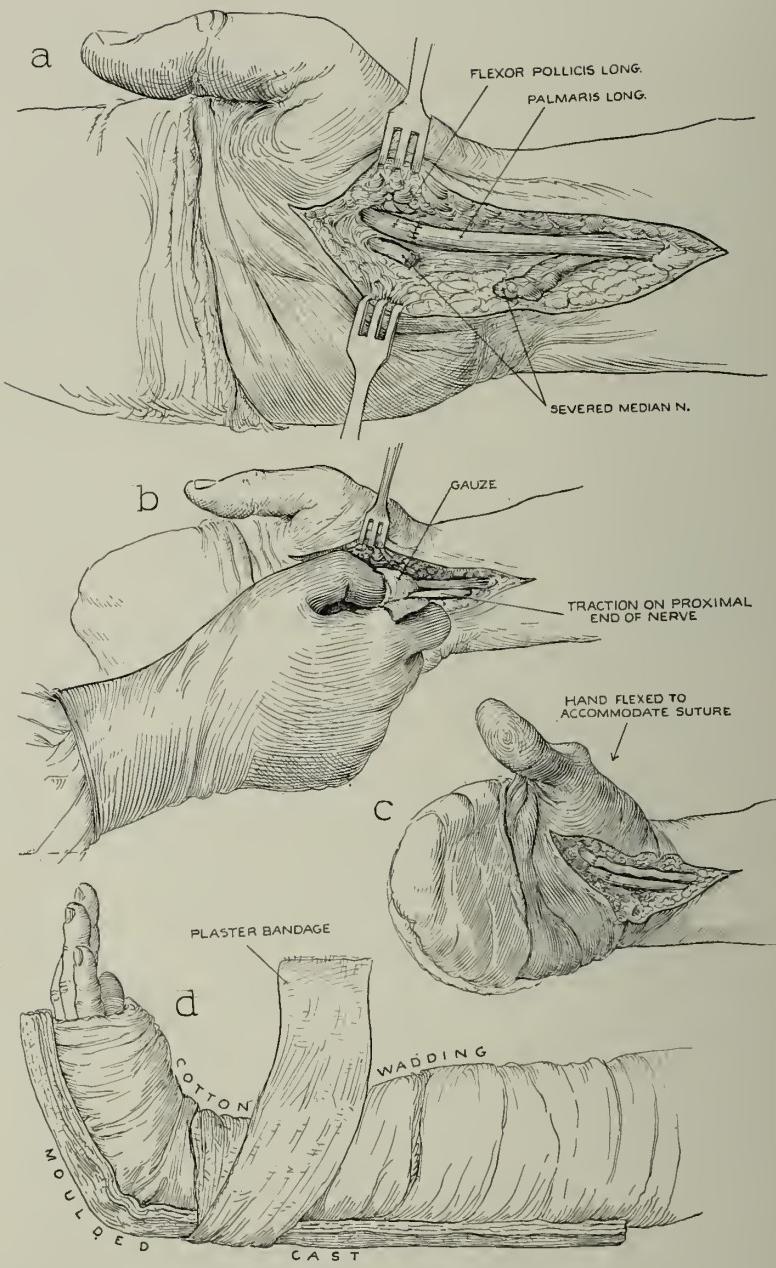


FIG. 573. Suture of median nerve with flexion accommodation of wrist. Drawn at time of operation by author.

The median nerve offers no motor supply to any muscle between shoulder and elbow, but serves in this capacity for all the flexor muscles of the forearm, with the exception of one and a half: the



FIG. 574. Suture of median and transplantation of palmaris longus to flexor longus pollicis, showing end-results.

flexor carpi ulnaris and inner half of the flexor profundus digitorum, and for four and one-half muscles in the hand. It transmits sensation from the outer two-thirds of the palm, from the palmar aspect of the thumb, the first and second fingers and the thumb side of the ring finger; it also transmits sensation from the dorsal tip of the thumb and the first and second fingers.

When the median nerve is injured from the cubital space upward, the patient is unable to pronate the forearm or to flex the distal joints of the thumb and the first finger. In many of these cases the hand is discolored over the thumb and the first and second fingers, the discoloration varying from a dark pink to blue black, due to a sympathetic involvement of the artery that accompanies the nerve. Furthermore, due to the flattening of the affected muscles in the palm of the hand over the thenar eminence it develops the appearance termed "ape hand." There is some tendency of the hand to incline toward the ulnar side. These with faradic tests give one a basis for diagnosis. One should also note nail and sensory changes.

TREATMENT. In respect to this nerve one is justified, when suspicious of a median lesion, in immediate exploratory investigation, because this nerve is very important for sensory purposes, it is subject to circulatory affections and causalgias, and even when sutured early does not undergo rapid recovery. Surgical measures on this nerve, when the injury occurs between the shoulder and elbow, are similar to those on the musculocutaneous nerve (p. 425).

Operation may be performed on the median nerve in the forearm, from the cubital space to the lower border of the annular ligament, where it commences to bifurcate. If treated immediately

FIG. 575.



FIG. 576.



FIG. 577.



Figs. 575-577. Median nerve lesion showing partial atrophy over thenar eminence and loss of full separation of thumb and first finger.

after injury, suture is practical even down to and at the sites of bifurcation below the annular ligament; but if surgical treatment is delayed, suture should not be attempted at or below the sites of bifurcation as there is usually too much destruction of tissue and it cannot be stretched. If the nerve is shortened, flexion at the wrist and elbow aid in effecting an end-to-end suture (Figs. 573 and 574). Great care must be taken, as in suture on all other peripheral nerves, to close the nerve sheath properly in order that a wild growth may not form in the surrounding tissues (especially in this nerve because of its tendency to a causalgia). After operation a posterior molded cast should be applied for forty-five days to maintain the arm and

wrist in flexion, and then the arm may be gradually lowered half an inch at a time until it is held straight.

I wish to emphasize at this point the tendency on the part of the physician to overlook a comparatively simple laceration at the wrist in which the nerve becomes involved. It is quite superficial, almost immediately beneath the palmaris longus tendon until it dips down beneath the annular ligament. I have had a number of such cases come to me for post-traumatic rehabilitation as a result of this oversight.

PROGNOSIS. The method of return of sensation depends upon the time when operation is performed. If performed immediately or within a few days after injury, sensation should begin to return within two to three months; but if operation has been delayed, and resection of tissue substance must be done because of an ascending and descending degeneration of the axis cylinder, the return of sensation will be much more slow. Motor regeneration in all cases returns only long after sensation has been reestablished, and in delayed cases sensation is extremely slow in coming back. In some instances the muscles never return to full volume even though sensation does.

Disability will extend over nine months to a year when suture has been done early. In late suture it will be two and a half to three years and function will not then be complete as in late suture there is almost always some specific loss.

CAUSALGIA

SYMPTOMS. Causalgia, a condition first described by Weir Mitchell during the Civil War, was very prominent during the World War. It means a painful nerve. It is quite common in both upper and lower extremities, involving the median and internal popliteal nerves. Occasionally it occurs, though rarely, in other nerves. In two instances I have seen it in the ulnar.

This condition is characterized in the upper extremities by definite pain throughout the nerve (particularly below the elbow in the area supplied by the nerve), sometimes to such an extent that any attempt even to touch the thumb, first and second fingers, results in the patient rapidly withdrawing the tested members.

The attitude of these patients is that of protection of the affected member with the other hand. There are the usual nail changes, together with muscular changes over the thenar eminence. The condition comes on gradually, and as it continues it increases in intensity to such an extent that the sufferers become affected mentally. Their faces become drawn, they are apprehensive, afraid of anybody coming near them. We also find a discoloration of the thumb, first and second fingers, which varies from a dark pink to blue, deep blue and sometimes indigo blue. This condition is relieved in the course of the operation for the relief of the causalgia. Where these conditions are found it is fair to assume that there is an injury directly or indirectly to the nerve. Many other symptoms are given by the author referred to above, and are well worth attention.

In the median nerve in a boy who had sustained a simple fracture of the humerus at the middle and lower third, a definite causalgia ultimately developed (case of Bruce King). Upon operation I found a very fine constricting band about the nerve producing an hour-glass contraction. Upon removal of the constriction the condition cleared up immediately.

TREATMENT. This not uncommon affection of the median nerve* is somewhat relieved by a simple dissection of any scar tissue that may have formed around the median nerve. Occasionally a suture, a re-suture and an entire resection is necessary. In cases in which the nerve is to all appearances normal, and reaction to faradism is normal, or at least present, an injection of 70 per cent alcohol within the sheath may relieve the causalgia. If there is a definite tumor formation it may be advisable to resect and re-suture entirely, especially where upon tests there are no evidences of reaction to regeneration. Otherwise the dissection of adhesions about the nerve with alcohol injection will usually accomplish the desired result. One can exercise considerable precaution by not only dissecting the adhesions away from about the nerve, but by injecting the sheath with 70 per cent alcohol at the same time, there being no harm in combining the two. Following suture sinusoidal galvanism should be applied to the muscles supplied by the affected nerve in order to keep them in a state of tone while neural regeneration is developing.

* Benisty, A. The Clinical Forms of Nerve Lesions. Univ. London Press, 1918; see also reference to Tinel, Stookey, et al., p. 414.

PROGNOSIS. The length of the disability period and the outlook for ultimate recovery vary widely, depending upon the extent of trauma and the length of time that has elapsed after injury before operative measures have been adopted. In cases in which ordinary suture has been performed immediately after the accident, a year and one-half to two years may elapse before complete recovery takes place; in cases in which operation has been delayed, two to three years may pass before recovery is complete, and even then it may not be complete. In the cases of delayed operation, the return of the power to perform the finer movements of the thumb and first finger is questionable, because of muscular degeneration and sensory changes. Some cases do not show any evidences of recovery even under the best care and technique. When the median nerve has been sutured the patient should be induced to return to some kind of work after three or four months, as these patients are likely to worry and may develop neuroses.

The disability in simple causalgia following removal of scar tissue and injection of 70 per cent alcohol will usually be from a few weeks to two and a half or three months.

INJURIES OF THE ULNAR NERVE

An injury involving the ulnar nerve only, between the shoulder and elbow, is very rare; it is usually accompanied by lesions of the median and musculocutaneous nerves.

SYMPTOMS. A lesion of the ulnar nerve is followed by loss of sensation along the inner side of the elbow and forearm to the hypothenar eminence, dorsally from the wrist down over the inner half of the hand, along the palmar third of the hand to the ulnar side of the ring finger and along the entire little finger.

If the lesion is above the elbow, the patient is unable to produce palmar adduction, flex the wrist toward the ulnar side and flex the ring and little fingers completely because of involvement of the inner half of the flexor profundus digitorum and flexor carpi ulnaris muscles. In conjunction with these findings the patient is unable to spread the fingers and thumb apart alternately. If requested to flex the fingers into the palm it is noticeable that though the flexion is apparently normal in the index and middle fingers, it is quite imperfect in the ring and little fingers. There is in the latter cases a notice-

able paralysis of the hypothenar muscles together with the interossei and inner two lumbricales, and to some extent the thenar as it supplies the inner half of the flexor brevis pollicis. When this is

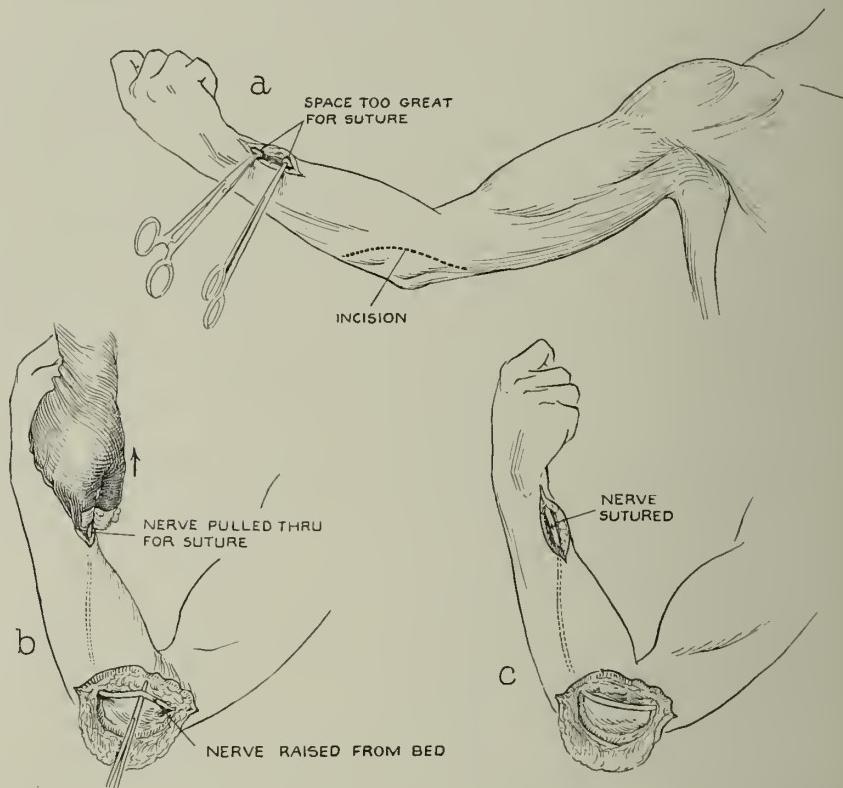


FIG. 578. Method of suture of short ulnar nerve showing transplantation at elbow and stretching.

present it is called the "claw hand," "main en griffe" or "hand of the griffin." For the same reason in the combined median and ulnar palsy and in a simple median lesion alone, the term "hand of the ape" is applied.

As in all peripheral nerve lesions the use of the Bristow coil is of advantage in determining the amount of degeneration below the seat of the lesion. If one is not trained in the use of the coil and very familiar with the anatomical relations, he should not attempt a diagnosis but should consult someone versed in this subject.

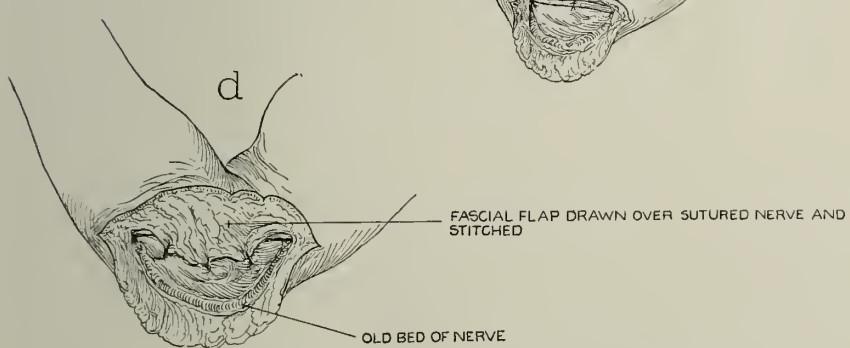
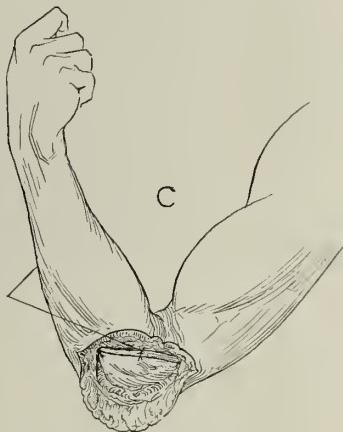
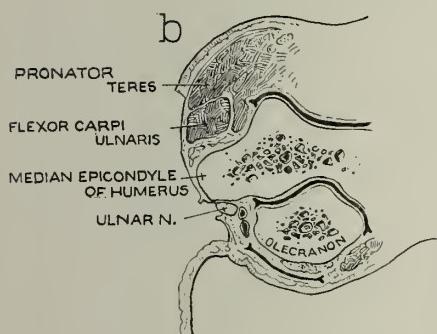
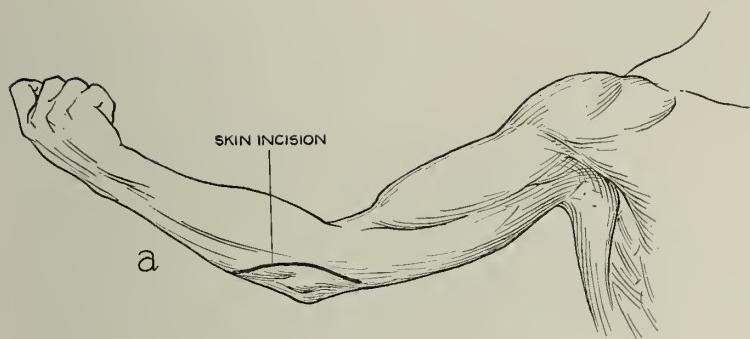


FIG. 579. Transplantation of ulnar nerve for lesions about elbow joint.

It is impossible in this book to go into all the symptomatic details; indeed it is not necessary as they are thoroughly covered by other authors.

FIG. 580.



FIG. 581.



FIGS. 580 and 581. End-results in case of suture of ulnar nerve. (See chart, Fig. 582.)

TREATMENT. If there is *any* suspicion of injury to the ulnar nerve, an immediate exploratory operation is justifiable. This may sound radical, but my reason for the statement is that this nerve is very important in its supply and a later operation is very apt to be of no material benefit because of the intervening muscular and neural changes that take place. Surgical treatment of this nerve, in an injury occurring between the shoulder and the elbow, is identical with that of the musculocutaneous nerve (p. 425). If the injury occurs between the elbow and the hand, *flexing the elbow* is useless as an aid in obtaining end-to-end suture, unless accompanied by nerve transplantation (see Fig. 579 showing nerve transplantation), because of the anatomical position of the ulnar nerve, as it lies posterior to the inner condyle of the humerus. In cases of marked shortening the nerve, where flexion of the wrist does not suffice, must be transplanted at the elbow to the cubital space, together

FRACTURE RECORD

Case No. 55536
Date 2-3-24 Hr. OPERATED
Dr. FORRESTER

Name <u>F. E. A.</u>		Address										
Age <u>57</u>	Sex <u>M.</u>	M. S. W. D. <u>White or Colored</u>										
Occupation <u>PASSENGER, CHICAGO RAPID TRANSIT LINES</u>		Time: Occurrence of Accident <u>9-20-24</u>										
Cause of Fracture		Hospital Entered <u>WEST SIDE HOSPITAL</u>										
		First Treatment <u>9-20-27</u>										
		X-Ray No.										
		Final Reduction										
EXAMINATION		TREATMENT	RESULT									
Bone <u>ND BONE INJURY</u>		Closed Reduction	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Good</td> <td style="width: 33%;">Moderate</td> <td style="width: 33%;">Bad</td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </table>	Good	Moderate	Bad						
Good	Moderate	Bad										
Site		Method and Position of Plaster	Anatomical Function Description of End Result, including Deformity, Shortening, Function, Pain, Swelling, Nerve (a) At discharge from Hospital Date (b) At discharge from O. P. D. Date (c) At subsequent date Date									
Type: Simple Transverse Compound Oblique Joint Spiral Subluxated Imported Cruciate Complicated		Anesthetic Used Yes No										
		Open Reduction										
		Method and Position of Plaster										
Description of Deformity including shortening												
Nature and Extent of Injury to Soft Parts <small>especially nerves and veins</small>		Anatomical Result obtained										
COMPLETE LOSS OF SENSATION ON ULNAR SIDE, HAND AND TYPICAL		Was non-operative treatment tried first?										
		How long after injury was operation performed?										
		Was internal fixation material subsequently removed?										
X-Ray		Why										
Before Reduction		When										
After Reduction		Period of Complete Immobilization										
At Discharge		Period of Protection										
Waardenburg Test		Total Period of Protective Treatment										
		Mortality Date										
		Absence from work: Duration										
		*Ability to resume job										
		*Present Wage earning capacity										
		Compensation obtained: Yes? No?										
		*Black Ink: Surgeon's Opinion Red Ink: Patient's Opinion										

Form 19/A.C.S. Case Record System
Form 19/A.C.S. Case Record System, Chicago

F. H.

EXAMINATION REVEALED:

TYPICAL ATROPHY OF SMALL MUSCLES OF HAND SUPPLIED BY THE ULNAR NERVE. NO REACTION OF REGENERATION. NO IMPULSE UPON FARADIC STIMULUS. A COMPLETE ABSENCE OF SENSATION OVER AREA SUPPLIED BY THE ULNAR NERVE.

P. H.

P. I.

(Details of Treatment, Operation, X-Rays, Diagrams, etc.) OPERATION REVEALED THERE WAS INTERPOSED A HYPERPLASIA OF CONNECTIVE TISSUE IN WHICH NO NERVE CYLINDERS PASSED THROUGH, INDICATING A COMPLETE SEVERANCE. A PORTION OF NERVE WAS RESECTED FROM BOTH THE DISTAL AND PROXIMAL ENDS UNTIL A NORMAL CONTINUITY OF AXIS CYLINDER WAS DEMONSTRATED AND WITH A FLEXION OF WRIST AND A STRETCHING OF NERVE, THE ENDS WERE APPROXIMATED WITH 00 CATGUT SUTURES. THE NERVE WAS THEN TRANSPANTED INTO A NEW FIELD AND THE WOUND CLOSED IN USUAL MANNER.

PHOTOGRAPHS TAKEN 1 YEAR LATER SHOW RESULTS.

Form 19/A.C.S. Case Record System
Form 19/A.C.S. Case Record System, Chicago

FIG. 582. Fracture record of case shown in Figures 580 and 581.

with flexing of the wrist. This is done by making a semicircular incision in the front of the elbow, exposing the nerve in its groove, carefully dissecting it out and transplanting it to the front of the



FIG. 583. Inoperable case of ulnar lesion existing below annular ligament.

arm, as shown in Figure 578. The nerve can be held down in place after transplantation by throwing a small pedunculated piece of fascia over the nerve and suturing it. *Great care* must be exercised in performing this operation of transplantation to avoid injuring the two fine branches which are given off from the ulnar nerve just below the condyle, one going to the inner half of the flexor profundus digitorum and the other to the flexor carpi ulnaris muscle.

After the operation of transplantation, or transplantation with suture, the arm must be held in flexion for at least thirty to forty-five days, and then gradually lowered, about half an inch at a time, to avoid sudden separation of the suture line or tearing of the fascial flaps.

This nerve can be surgically treated down as far as the annular ligament at the wrist; but only very seldom are surgical measures successful below this point, and then only in cases operated upon immediately after injury, in which there is very little tissue destruction.

PROGNOSIS. In early immediate suture of the ulnar the prognosis is more favorable, but even then one should not expect complete recovery, as the small muscles of the hand may undergo muscular changes that prohibit complete return. In early suture the disability will run one and one-half to two years. In delayed suture, such as

three to six months, it may extend two and one-half to three years and then not be complete. In fact, even in immediate suture it is rare to see a complete recovery, as there is almost always some specific loss. This does not mean that the hand will necessarily be useless even to the laboring man. In 2 cases in my own practice there was a definite permanent atrophy, but both patients after a settlement was made returned to their occupations, one as a brick-layer, the other as a machinist. Patients should return to their work four to six months after operation for two reasons, to avoid mental complications and to acquire compensatory training.

INJURIES OF THE ANTERIOR CRURAL (OR ANTERIOR FEMORAL) NERVE

Injury of the anterior crural nerve is very unusual because this nerve does not begin to bifurcate until it reaches a point just below the curve of Poupart's ligament. The femoral artery and veins are much more likely to be injured first, or at least in conjunction with the nerve. During the war I saw one case where the nerve was injured without the artery and vein being involved.

SYMPTOMS. Injury to this nerve is characterized by inability to extend the leg on the thigh.

TREATMENT. The treatment is similar to that used in cases of injury of any other peripheral nerve. Early surgical interference is justified because of the immediate bifurcations at the femoral exit and the fact that the branches are small and when severed, early suture is necessary to obtain results.

PROGNOSIS. Do not look for return of any muscular innervation under nine months to a year; or for recovery under two to three years.

INJURIES OF THE GREAT SCIATIC NERVE

SYMPTOMS. Sciatic nerve injuries are of infrequent occurrence, outside of war injuries. If they are characterized by complete severance of the nerve they are marked by the inability of the patient to flex the leg on the thigh with the degree of strength present in the uninjured limb and by inability dorsally to extend the foot or develop plantar extension; also definite changes in circulation and in the appearance of limb and nails, and eventually trophic

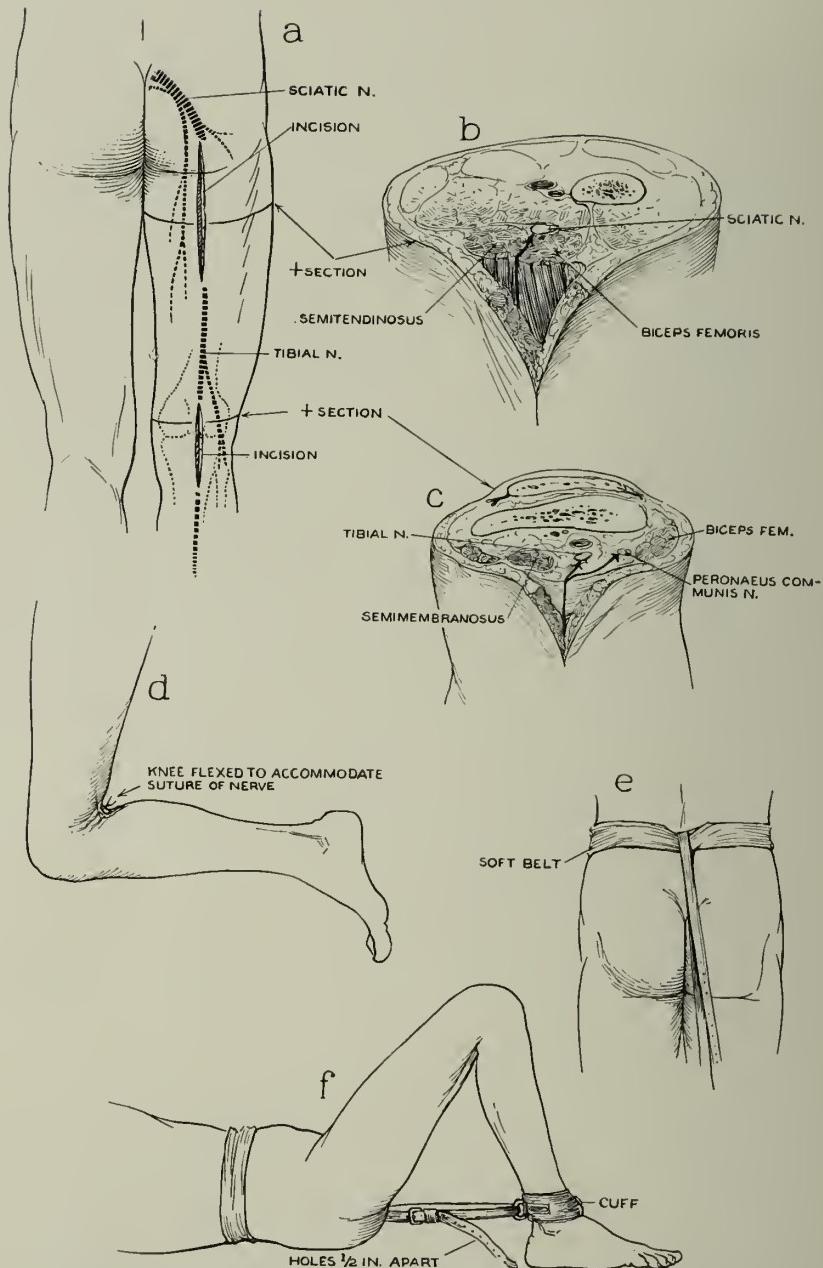


FIG. 584. Approach to sciatic nerve and method of holding limb in flexion during union and, through use of strap, ability to lower distal limb gradually.

ulcers on the bottom of the foot. These, together with well-defined sensory changes and reaction of degeneration faradically, complete the picture. Again, one must be thoroughly versed in anatomy to

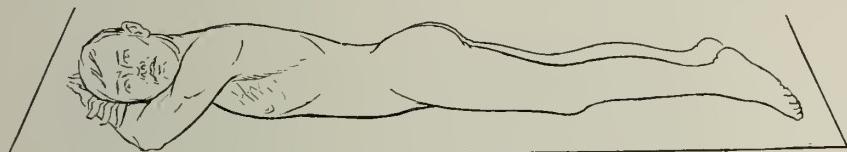


FIG. 585. Position for approach to sciatic nerve.

segregate the parts affected. When not trained one should call upon the neurologist who is. Partial severance of the nerve results in

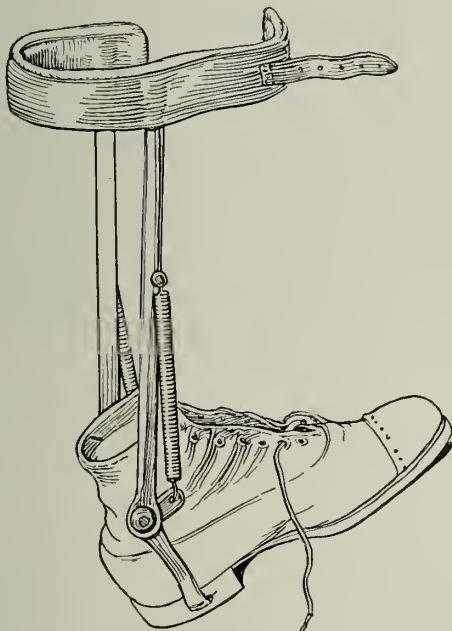


FIG. 586. Drop-foot shoe.

varying degrees of functional disability, which can be estimated by certain balance tests.

TREATMENT. Where faradic tests show only a partial lesion of the sciatic, it is often very difficult to decide whether surgical interference is necessary. The injury, which may be only slight objectively, again

makes it very difficult. One is justified, however, where the involvement is in the anterior tibial or peroneal nerves, to advise an exploratory operation, for regeneration is very slow in these, as in the

FIG. 587.



FIG. 588.



Figs. 587 and 588. Case of lacerated wound, right popliteal space, fracture of lower right femur and rupture of sciatic nerve. Operation: end-to-end anastomosis with 5 in. gap overcome by flexion of knee with stretching. Lateral views showing amount of plantar and dorsal flexion. Man is working as a carpenter without any prosthetic apparatus.

ulnar and median in the hand, and certainly no harm is done providing one knows his histology, pathology and anatomy.

In the surgical treatment of sciatic nerve injuries, the surgeon who thoroughly knows the anatomy of the affected region will find the approach not difficult. (The position of the patient is shown in Fig. 585.) The proper skin incision is a perpendicular line drawn midway between the outer and inner side of the leg at the gluteal fold. If one so desires, the path of incision can be indicated the night before operation by the application of a line of iodine or mercurochrome. As the incision is made, the surgeon must keep in mind the fact that the sciatic nerve has as its anatomical boundary

line the lower border of the gluteal maximus above, the long head of the biceps muscles externally and the semitendinosus and semi-membranosus muscles internally.



FIG. 589. Same case as Figures 587 and 588. Posterior view showing length of scar and size of limb.

Unfortunately, injury to this nerve is not always recognized and repaired early. On this account, in performing a late suture, the surgeon must be prepared to find intraneuronal changes and to do a partial resection of the nerve, an operation demanding flexion of the knee and also, sometimes, stretching before approximation can be obtained. In order to eliminate as much postoperative suffering as possible, from forced flexion of the knee, the patient should walk about for a few days before operation, or should lie in bed with the limb flexed as much as possible at the knee.

If the nerve is found to be only incompletely severed, and suturing results in a kinking of the uninjured portion, this kink should not be allowed to remain but should be separated, transplanted through a portion of muscle or fascia and, if necessary, covered with fascia. If this is not done, causalgia may result in the normal nerve, particularly where there is a possible kinking of the external popliteal nerve.

Occasionally, in cases of injury of some months' duration, approximation will be found impossible or difficult, even with flexion of the knee. In such cases a slight amount of traction may be exerted on both the proximal and distal ends. More nerve substance can be obtained from the proximal than from the distal ends in this manner. By means of traction and joint flexion, the surgeon should be able to approximate at least a 5 inch gap.

In suturing this nerve, great care must be taken to close the sheath completely, because, as in the median nerve, of danger of causalgia, especially where the internal popliteal is involved.

When suturing has been done, the limb should be kept flexed, as shown in Figure 584, for at least forty-five days. It should then be lowered only a quarter to a half inch at a time. After full extension has been attained, passive and active motion may be begun, in conjunction with slow sinusoidal galvanism to the muscles supplied by the injured section of the nerve. The sinusoidal galvanic treatment should be given, whenever possible, three times a week. In cases in which the anterior tibial muscle is also injured and a drop-foot exists, a shoe like that shown in Figure 586 should be worn. If expense need not be considered the shoe may be made neater than that shown in the figure, with an arch plate within the shoe, a side iron up to the calf, a leather cuff around the calf and an ankle check at the swivel inside the shoe.

PROGNOSIS. In cases in which partial or complete suture is performed, the disability period lasts from a year and one-half to three years, depending on the severity of the injury and the time which elapsed after injury before treatment was begun. Total disability will be nine months to a year, and if at this time the patient can wear a drop-foot shoe, he can be working while the nerve undergoes regeneration. However, in complete sciatic lesions the longer the operation is delayed, the longer the recovery. In 1922 I operated on a complete sciatic lesion, suturing the divisions in the popliteal space. The patient has ability to control all muscular groups below the knee (in fact is working as a carpenter), but they are all weak and the volume of the limb, when examined in September, 1927, was not as great as normal.

VOLUNTARY AND FARADIC CHART ON CASE SHOWN IN FIGURES 587 AND 588.

MUSCLE POWER OF RIGHT LOWER LEG

Muscles	Faradism	Voluntary response
1. Anterior tibial.....	Slow	Fair
2. Extensor proprius hallucis.....	Negative	Fair
3. Extensor longus digitorum.....	Negative	Negative
4. Peroneus tertius.....	Negative	Negative
5. Peroneus longus and brevis.....	Negative	Poor
6. Extensor brevis digitorum.....	Poor	Negative
7. Soleus and tibialis posterior.....	Negative	Negative
8. Plantar flexor toes.....	Negative	Negative
9. Gastrocnemius.....	Good	Fair

Circulatory changes, cool skin, mottling with some cyanosis.

INJURIES OF THE POPLITEAL SPACE

Several important nerve bifurcations occur in the region of the popliteal space. The sciatic nerve makes its bifurcations considerably above this space. Approximately 4 to 5 inches above the condyles of the femur the division of the internal and external popliteal and musculocutaneous takes place. When the external popliteal reaches the insertion of the biceps femoris muscle, it splits into the anterior tibial and musculocutaneous divisions. Because of these complicated bifurcations, diagnosis and treatment of injuries of these nerves call for accurate anatomical knowledge on the part of the physician.

SYMPTOMS. Involvement of the anterior tibial nerve causes definite sensory changes. A simple test is a loss of sensation at the triangular space at the base of the great and second toes. This, with an inability to draw the foot up or flex the member dorsally, together with a loss of reaction to faradism, completes the picture.

When the musculocutaneous nerve is involved there is inability to evert the foot *when held on a horizontal plane* with slight plantar extension. This should be carefully observed, because if dorsally flexed beyond that point the patient can call upon the dorsal extensors supplied by the anterior tibial. The sensation along the fibular region terminating just external and anterior to the fibula should also be tested.

Where the internal popliteal is involved there is inability to flex the foot plantar muscles and to invert the foot, accompanied by sensory changes.

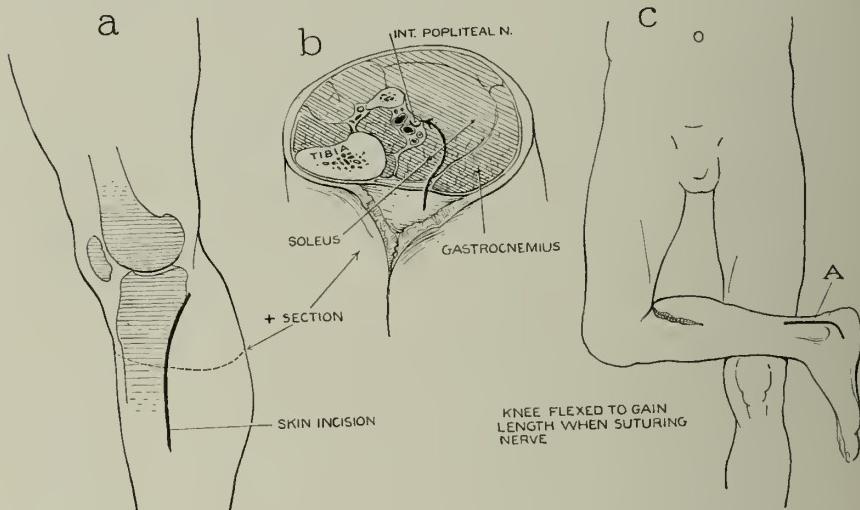


FIG. 590. Position of selection for approach to internal popliteal and posterior tibial nerves below knee.

TREATMENT. The anterior tibial nerve is *inoperable beyond the head of the fibula*. The musculocutaneous nerve is *inoperable after it enters the peroneus longus*. In operating upon these nerves in the popliteal space, the same technique and after-care can be followed out as in the sciatic higher up, such as stretching and flexion of the knee, together with the belt-lengthening process (see Fig. 584).

Below the knee or popliteal space the only operable nerve is the internal popliteal. The correct operative position for operation on this nerve is shown in Figure 584, the patient lying on his back with the affected leg crossed at right angles over the normal one. The incision is made anterior to the belly of the gastrocnemius muscle down to and through the soleus. This position should be adopted for all operations on the internal popliteal from just below the popliteal space down to the ankle joint, at its bifurcation into the internal and external plantar nerves.

In cases of shortening of the internal popliteal, flexion of the knee and stretching of the nerve are advisable. After suture the limb

must be kept flexed for at least forty-five days, then gradually extended an inch at a time, as in the sciatic. Sinusoidal galvanism and passive massage are important therapeutic aids for months afterward.

PROGNOSIS. In anterior tibial nerve lesions a drop-foot shoe can be worn after the first five to six months, so that the patient can do some kinds of work. Recovery takes place in one and one-half to three years and is not always complete then.

In the musculocutaneous lesion the patient should wear a splint giving lateral stability of the ankle, particularly holding the foot from inverting, and a temporary total disability can be avoided by wearing a prosthetic shoe for four to six months after operation. However, it will be one and a half to two years before complete recovery. In the internal popliteal this total disability will run six to nine months, but it will be two to three years before complete recovery can be finally decided on.

CHAPTER XXI

OSTEOMYELITIS

OSTEOMYELITIS is recognized under two types, acute and chronic. The intimate pathology of these is thoroughly described and demonstrated by Scudder in the last edition of his textbook on fractures.*

It may arise from a focal condition within the body or from without, following a traumatic or surgical exposure of the part and commonly following the too early surgical invasion of a bone. Surgeons are prone to attempt surgery of a bone too soon following a fracture, thus adding to the injury; whereas if they would wait at least a week, and if possible longer, a great deal of post-traumatic osteomyelitis would be avoided. In remarking upon this I have heard many physicians state that they were forced to operate early because of criticism by the family or by some interested outsider, for waiting. That is wrong. A surgeon should stand by his convictions; and I feel satisfied that if he clearly informs the immediate family of the exact situation, he will not lose his case.

ACUTE OSTEOMYELITIS

This type is recognized, in the absence of open wounds, by acute pain over the affected area and occasionally, though not always, by redness, swelling and tenderness to pressure. A definite increase in the leucocyte count, and occasionally a local adenitis will aid in diagnosis. This, together with a history of an acute fever, a focal infection or a local trauma, will assist to complete the diagnostic picture. Of course, when there is a local compound condition which has been followed by infection, the diagnosis is comparatively easy.

TREATMENT. In view of the fact that in writing this book I am describing only the methods found satisfactory in my own practice, I will not discuss the many methods written and described, as they can be found in the literature. Such are Chutro's, Orr's described in a recent report, † etc.

* Scudder, C. L. *The Treatment of Fractures*. Ed. 10, Saunders, Phila., 1926.

† Orr, H. W. *Treatment of osteomyelitis and other infected wounds by drainage and rest*. *Surg. Gynec. & Obst.*, 1927, xlv, 446.

During the War I had the pleasure of acquaintanceship with Captain McKenzie of the R.A.M.C., with whom I was associated in Alder Hey Military Hospital. He, in view of the fact that we had a great many cases of acute and chronic osteomyelitis in the hospital, suggested trying Morison's bipp technique. Rutherford Morison of Newcastle, England, has written a small book entitled "Bipp Treatment of War Wounds."* I wrote Mr. Morison requesting permission to refer to his technique, and record the following reply:

"The only improvement I made on my methods is to dress the wound sooner than at first. On the second or third day I have removed the dressing, covered the wound with gauze soaked in spirit and washed away any discharge on the skin with a spirit swab, redressing it as before. During the war we were so busy that wounds were left undressed as long as possible, and when there is not much discharge this is still ideal, but I think it is well to ascertain this by looking on the second or third day. If everything is clean they can then be left untouched indefinitely."

I might say before describing the technique that we used it extensively in Alder Hey Military Hospital with excellent results and a reduction in our work and that of the nurses.

TECHNIQUE

First, it is advisable to have two tables of instruments which can be designated as pus and clean tables, the pus table to contain instruments for exposing the infected part and removing bone and sequestra, etc., the clean table to contain instruments for removal of free fat transplant. The following procedures are then indicated:

1. Use a tourniquet when possible, as a dry field gives greater opportunity to define pathological tissue macroscopically.
2. Disinfect the surrounding field with a 1:20 carbolic solution.
3. Make the incision sufficiently long to get a thorough exposure of the field.

* Morison, Rutherford. *Bipp Treatment of War Wounds*. Published by the joint committee of Henry Frowde and Hodder & Stoughton, Oxford Press Warehouse, London, 1918. It can be purchased in this country, and contains some sixty-seven pages of reading matter. In my estimation the information contained therein is invaluable.

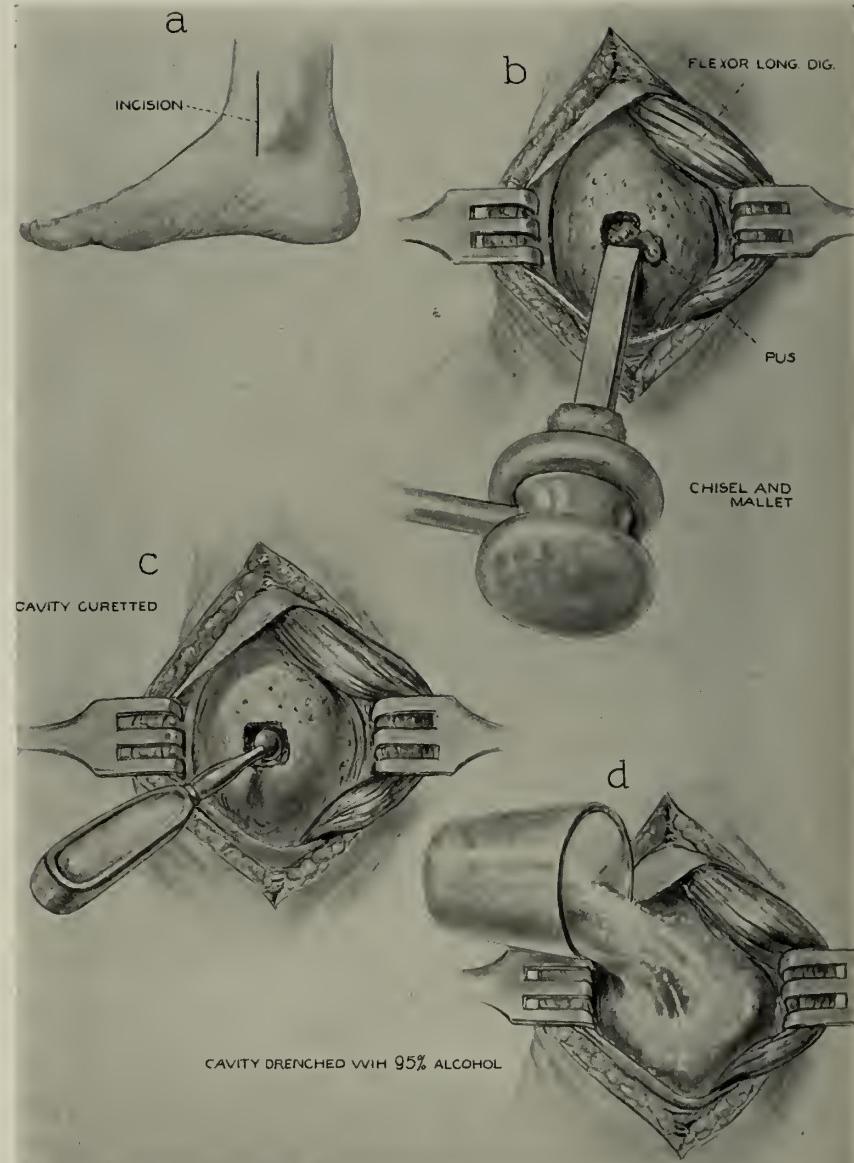


FIG. 591. Operation devised by Rutherford Morison of Newcastle, England. Technique printed by his permission, showing bipp technique. Actual operation by author.

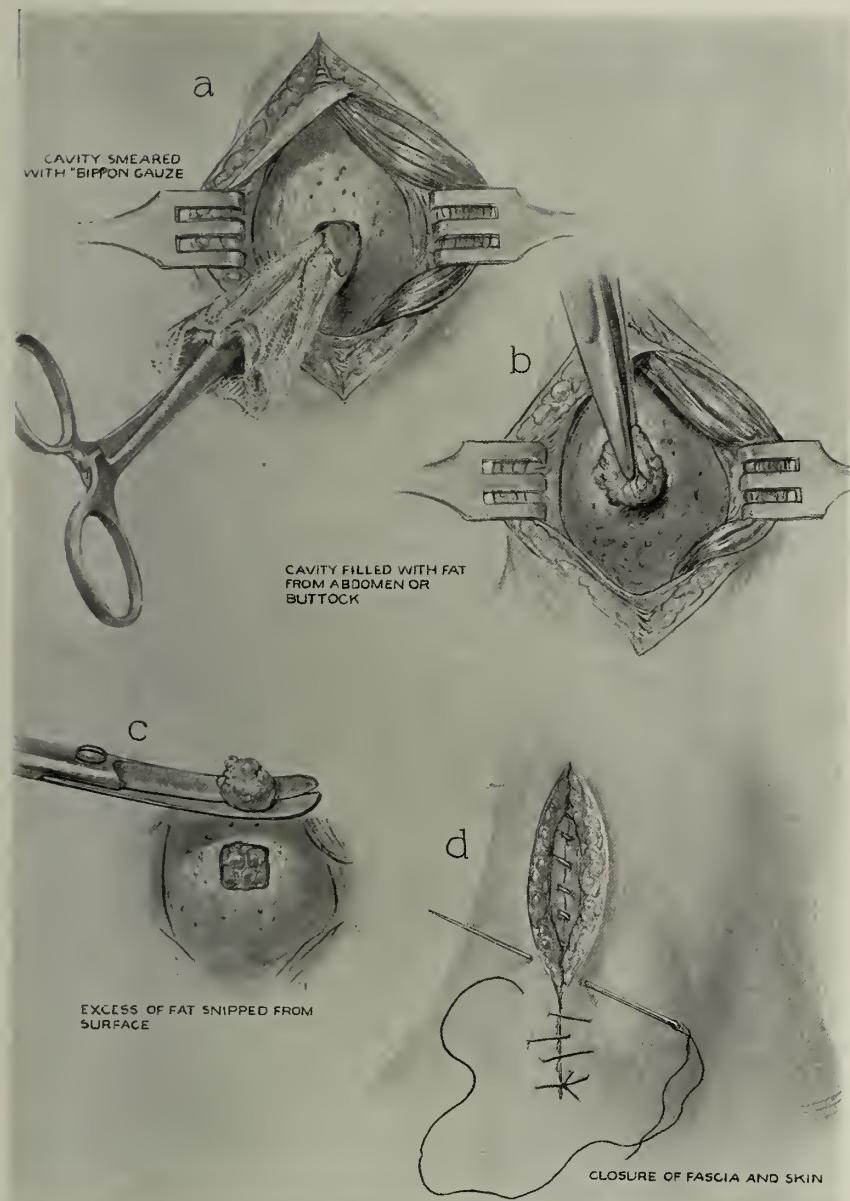


FIG. 592. Continuation of operation shown in Figure 591.

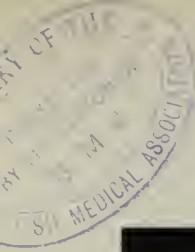


FIG. 593.

FIG. 594.

FIGS. 593 and 594. Acute suppurative osteomyelitis, showing *Streptococci albus* and *aureus*.

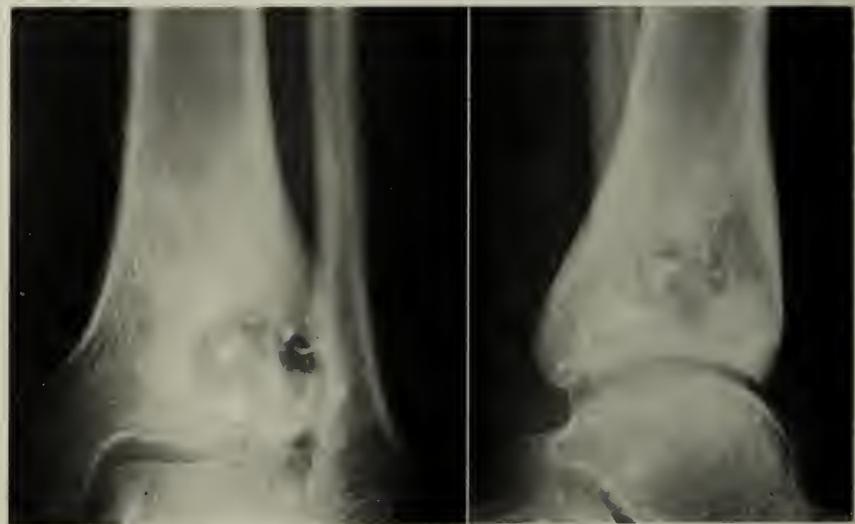


FIG. 595.

FIG. 596.

FIGS. 595 and 596. Same case as Figures 593 and 594. Appearance six months after operation.

4. In cutting or chiseling into bone make the opening sufficiently large to give free access to the diseased cavity in order to be sure of removing all devitalized bone.



FIG. 597.



FIG. 598.

Figs. 597 and 598. Same case as Figure 593, showing degree of plantar and dorsal flexion following operation.

5. After all pathological debris is removed, fill and gently mop dry the field with c.p. alcohol.
6. Then with a piece of gauze or with fingers wipe all surfaces with a film of bipp paste.*
7. If there is a cavity in the bone fill it as follows:
8. Change gown and gloves, in order to prevent contaminating the clean wound. Use clean table and remove from either buttocks or abdomen a piece of free fat sufficient to fill the cavity to the surface of the bone. When there are capable assistants one can be designated to do this so that the surgeon need not change.
9. Gently mop fat transplant with bipp paste and place it in cavity, cutting off any surplus level with the bone surface.
10. Close skin surface with sutures, silk or silkworm. When there is any tension deep silk sutures can be used, threading a short

* Bipp paste (B.I.P.P.) is composed of bismuth subnitrate, one part; iodoform, two parts; paraffin paste, q.s. Some drug houses in this country are selling a B.I.P.P. composition with vaseline as a base. It is preferable for the surgeon to make his own, as vaseline is impracticable and instead of producing a film on the tissues produces streaks.

section of rubber cathether on the exposed part to prevent tearing of the skin.

11. Dress wound with gauze wrung out of alcohol and apply abundant gauze or cotton dressing, so that there will be *no pressure over the wound*.
12. Fix limb in any method of choice, such as splints or cast.
13. The following day change all dressings and allow them to remain on without any interference for at least two if not three weeks.

CHRONIC OSTEOMYELITIS

The above method is of equal value in all cases of chronic osteomyelitis.

In the chronic type one occasionally hesitates in taking radical action, particularly in the Brodie's abscess type, because of the possibility of confusing it with malignancy, in which event one is justified in acting conservatively by taking tissues for examination and then later doing a secondary closure, using the Morison method.

Otherwise, in the open discharging type with definite history one can use the method already described.

One need not hesitate to operate on these cases, no matter how free the discharge.

One can, when in doubt in chronic cases where there is a sinus, inject the sinus with Beck's paste and that will act as a definite guide as to the extent of bone involvement.

It is interesting to note that in some of the low-grade chronic infections with a small amount of discharge, providing there is no sequestrum, the simple injection of Beck's paste will clear up the entire condition.



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